DISSERTATION

FOR THE AWARD OF DEGREE

MASTER OF SCIENCE- MEDICAL IMAGING TECHNOLOGY

SESSION 2022-2024

Topic:

A STUDY TO CHECK THE RADIATION SAFETY AND STANDARD OPERATIONAL COMPLIANCES GUIDELINES BY AERB IN RADIODIAGNOSIS DEPARTMENT OF WESTERN UTTAR PRADESH HOSPITALS, INDIA.

By

SUNIL KUMAR

REG.NO- 950122477/22MIT016

DEPARTMENT OF RADIODIAGNOSIS

SANTOSH DEEMED TO BE UNIVERSITY

NO. 1, SANTOSH NAGAR, GHAZIABAD-201009,

DELHI NCR, INDIA

SANTOSH
Deemed to be University

COPY RIGHT CERTIFICATE

DECLARATION BY THE CANDIDATE

I hereby declare that Santosh Deemed to be University, Ghaziabad, (U.P) shall have the right to preserve, use and disseminate this Dissertation title. **"A Study to Check the Radiation Safety and Standard Operational Compliances Guidelines by AERB in Radiodiagnosis Department of Western Uttar Pradesh Hospitals, India."** in print or electronic format for academic or research purposes.

Signature of Candidate

Date:

Place:

SANTOSH
Deemed to be University

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation title **"A Study to Check the Radiation Safety and Standard Operational Compliances Guidelines by AERB in Radiodiagnosis Department of Western Uttar Pradesh Hospitals, India."** is a bonafide genuine research work carried out by me under the esteemed guidance of my Guide Ms Neelam Rao Bharti Department of Radiodiagnosis Santosh Deemed to be University, Ghaziabad, (U.P)

Signature of Candidate

Date:

Place:

SANTOSH
Deemed to be University

CERTIFICATE BY THE GUIDE

This is to certify that the dissertation title **"A Study to Check the Radiation Safety and Standard Operational Compliances Guidelines by AERB in Radiodiagnosis Department of Western Uttar Pradesh Hospitals, India."** is a bonafide genuine research work carried out by Sunil Kumar in partial fulfilment of the requirement for the degree of MSc- Medical Imaging Technology under my supervision and guidance in department of Radiodiagnosis Santosh Deemed to be University, Ghaziabad, (U.P)

GUIDE:

Name: Neelam Rao Bharti

Designation: Assistant Professor

Department: Radiodiagnosis

Santosh Deemed to be University, Ghaziabad-201009

SANTOSH
Deemed to be University

CERTIFICATE BY THE CO-GUIDE

This is to certify that the dissertation title **"A Study to Check the Radiation Safety and Standard Operational Compliances Guidelines by AERB in Radiodiagnosis Department of Western Uttar Pradesh Hospitals, India."** is a bonafide genuine research work carried out by Sunil Kumar in partial fulfilment of the requirement for the degree of MSc- Medical Imaging Technology under my supervision and guidance in department of Radiodiagnosis Santosh Deemed to be University, Ghaziabad, (U.P)

CO-GUIDE: **Name: Himanshu Kumar Mishra**

Designation: Assistant Professor

Department: Radiodiagnosis

Santosh Deemed to be University, Ghaziabad-201009

SANTOSH
Deemed to be University

CERTIFICATE BY THE HEAD OF DEPARTMENT

This is to certify that the dissertation title **"A Study to Check the Radiation Safety and Standard Operational Compliances Guidelines by AERB in Radiodiagnosis Department of Western Uttar Pradesh Hospitals, India."** being submitted by Sunil Kumar in partial fulfilment of the requirement for the degree of MSc- Medical Imaging Technology is based on the bonafide work carried out by him in department of Radiodiagnosis Santosh Deemed to be University, Ghaziabad, (U.P)

Name: Dr. Ashok Kumar Sharma

Designation: Head of the Department

Department: Radiology

Santosh Deemed to be University,

Ghaziabad-201009

ENDORSEMENT BY DEAN ACADEMICS OF THE UNIVERSITY

This is to certify that the dissertation title **"A Study to Check the Radiation Safety and Standard Operational Compliances Guidelines by AERB in Radiodiagnosis Department of Western Uttar Pradesh Hospitals, India."** is a bonafide genuine research work carried out by Sunil Kumar himself under the esteemed guidance of Ms Neelam Rao Bharti Santosh Deemed to be University, Ghaziabad, (U.P)

Dr Shalabh Gupta

MBBS, MS

Dean Academics

Santosh Deemed to be University,

Ghaziabad-201009

SANTOSH
Deemed to be University
(Established u/s 3 of the UGC Act, 1956)

STATISTICIAN CERTIFICATE

This is to certify that the statistical analysis component of the dissertation titled **"A Study to Check the Radiation Safety and Standard Operational Compliances Guidelines by AERB in Radio diagnosis Department of Western Uttar Pradesh Hospitals, India."** done by Dr. Amod Singh- Assistant Professor Biostatistics Department Of Community Medicine Santosh Medical College and Hospital Ghaziabad , has been conducted under my direct guidance and supervision. All the statiscal calculations of this study are authentic and correct to the best of my knowledge.

Wish him all the success in his life.

Dr. Amod Singh
Assistant Professor Biostatistics
Community Medicine

SANTOSH
Deemed to be University
(Established u/s 3 of the UGC Act, 1956)

ANTI PLAGRISM DECLARATION/UNDERTAKING

I hereby declare that this dissertation present title **"A Study to Check the Radiation Safety and Standard Operational Compliances Guidelines by AERB in Radio diagnosis Department of Western Uttar Pradesh Hospitals, India."** submitted by me to Santosh University is an original research work. I also hereby declare that there is a similarity in contents found 1% after plagiarism check and the present research work has not been submitted for the award of any degree/diploma of the same Institution or to any other Institution, where the work was carried out.

(Sunil Kumar) **(Guide- Neelam Rao Bharti)**

I have verified the contents of the Thesis through OURIGINAL by Turnitin and it is showing similarity less than 10% in plagiarism check.

(Signature of Dean Research)

ACKNOWLEDGEMENT

I express my deepest gratitude to my HOD- Dr. Ashok Sharma, Guide Ms. Neelam Rao Bharti and Co-Guide Mr. Himanshu Mishra whose expertise, guidance and unwavering support have been invaluable throughout the course of my research and writing of this. Their encouragement and insightful feedback have been instrumental in shaping this work.

I also extend my sincere to my professors, whose wisdom and mentorship have greatly enriched my academic journey. Additionally, I am grateful toto the faculty and staff of the department of radiology, whose assistance and cooperation have been essential. I am grateful to my fellow trainers for their support. Which has made this journey more enriching and enjoyable.

I am deeply indebted to my family for their support. Lastly, I thank all RSO and Technicians who participate in this study, whose willingness to contribute to medical research is deeply appreciated.

Sunil Kumar
MSc- MIT
Session-2022-2024

CONTENTS

S.No	INDEX	PAGE NO
1	INTRODUCTION	1-16
2	AIMS AND OBJECTIVE	17
3	REVIEW OF LITERATURE	18-45
4	MATERIALS & METHODS • DATA COLLECTION • SAMPLE SIZE • METHODOLOGY • EXCLUSION & INCLUSION CRITERIA • DURATION OF PROJECT • ETHICAL APPROVAL	46-47
5	RESULT SUMMARY	48-53
6	DISCUSSION	54-58
7	CONCLUSION	58
8	REFRENCES	59-63
9	APPENDIX A	64-70

List of Tables

		Page no.
Table 1	Demographic Variable	48-49
Table 2	Independent Samples Test	53
Table 3	Independent Samples Test	54
Table 4	Independent Samples Test	55

List of Graphs		Page. No
Graph 1	Age	50
Graph 2	Gender	50
Graph 3	Education	51
Graph 4	Experience	51
Graph 5	Employment	52
Graph 6	Area	53

LIST OF ABBREVIATIONS		
S.No.	**Abbreviations**	**Full Form**
1	AERB	Atomic Energy Regulatory Board
2	ALARA	As Low as Reasonably Achievable
3	ARS	Acute Radiation Syndrome
4	BMD	Bone Marrow Densito Meter
5	CT	Computed Tomography
6	CBCT	Cone Beam Computed Tomography
7	DRL	Diagnostics Reference Level
8	DLP	-Dose Length Product
9	DAP	Dose Area Product
10	eLORA	Electronic Licensing of Radiation Application
11	HCW	Health Care Professional
12	ICRP	International Commission for Radiation Protection
13	IOP	Intra Oral Periapical
14	LD	Lethal Dose
15	MSV	Millisievert
16	MRI	Magnetic Resonance Imaging
17	NRPB	National Radiological Protection Board
18	OPG	Orthopantogram
19	QA	Quality Assurance
20	RPR	Radiation Protection Rule
21	RSO	Radiation Safety Officer
22	RP- KAP	Radiation Protection- Knowledge Attitude and Practice
23	RPC	Radiation Protection Culture
24	RCO	Radiation Chief Offcer
25	TLD	Thermo Luminescent Dosimeter
26	WHO	World Health Organization

ABSTRACT

Background: For patient and healthcare worker safety, radio diagnosis departments must follow radiation safety and regulatory criteria. Hospital Radiation Safety Officers (RSOs) and technicians in Western Uttar Pradesh, India, are assessed for AERB knowledge and compliance.

Objective: The main goals is to examine RSOs and technicians' knowledge of ELORA (e-Licensing of Radiation Applications) compliance, safety device compliance, and general radiation safety compliance, especially in rural regions.

Material and Methods: In Western Uttar Pradesh, 306 RSOs and technicians working in radio diagnosis departments were given a structured questionnaire via Google Forms, which was used to conduct a cross-sectional survey. The questionnaire addressed ELORA compliance, safety device compliance, and general radiation safety compliance. It was created based on prior research and AERB ELORA compliance software. The institution provided ethical clearance before the data was collected, which took place in January–June 2024.

Results: The t-test indicated that there were large gaps in respondents' knowledge. Specifically, in rural regions, the t-values for general radiation safety compliance, safety device compliance, and ELORA compliance.

Conclusion: RSOs and technicians, particularly in rural areas, lack radiation safety and compliance skills, according to the report. To increase compliance and radiation safety, these gaps need focused education. Train and enforce safety requirements regularly, especially in rural locations where gaps in knowledge are greater.

1 INTRODUCTION

Radiology is the area of medicine that uses X-ray radiation. The radiology department has multiple diagnostic radiology equipment's like - CT Scan, X-ray (Mobile and Fixed), OPG, BMD and mammography these equipment's generating the ionizing Radiation after applying the current. X-ray radiation is a type of energy or propagation of energy discovered by W. C. Roentgen, 8th November 1895. Radiation has the power to both save and harm lives. This radiation required a safety compliance and does not cause undue risk to the health of people, occupational and the environment Radiologic technologists use the radiation to provide quality medical radiography, Ionizing radiation can cause harmful effects not only to the subject who is exposed to it, but also to their future generations. AERB guided us about how to use the radiation as per RPR-2004 and set the regulatory framework of radiation safety and standard compliances. The radiation safety and protection awareness of RSO- radiation safety officer and technicians is very important to minimize the occupational exposure hazards and they must be aware about the radiation safety an its AERB regulatory compliances . the important parameter to rule out the dose measuring of the radiation workers how they are using the TLD badge, whether all workers have TLD badge, the proper storage of TLD badge, whether all staff know about how to wearing the TLD badge. The Periodic area surveillance and quality assurance of radiation generating equipment's is compulsory for radiation protection. Safety service report to be filed at least once in a year on AERB Elora software. Separate protocols for adults and pediatric patients displayed at console room. Gonad shield may be quite effective as it can lower the dose to the testes. Equipment's are safe and secure from radiation safety point of view operational status of equipment's also updated in ELORA software. Radiation on/off light indicator should be connected to the radiation source at the entry gate of every radiation equipment. Record of service and maintenance, Periodic QA should be updated and timely done. shielding adequacy should be available and satisfactory with protective barrier, viewing window glass and lead lined doors. As a result, 53 articles were retrieved from three data base. Of these only 15 articles are eligible and included. "The International Commission on Radiological Protection (ICRP) provides guidelines about radiation protection based on three principles of justification, optimization, and limitation and also states as low as a reasonably achievable" [1]. Advancement

in the healthcare profession increases the use of radiation. Commonly used radiation monitoring device in radiology is TLD Badge, But due to lack of awareness, most of the professionals avoid to wear the badge''[2]. Attitude towards radiation safety challenges at work [3]. '' The lack of adequate and skilled occupational also a concern [4]. 'The professional capabilities of radiographer includes several skills like teamwork skill, risk management, knowledge, professionalism, communication skills, safety and critical thinking skills [5]. 'A majority have neither a national regulatory framework for radiation safety nor a regulatory body. Most of developing countries have a shortage of qualified radiation protection experts, also a lack of formal education and training [6]. '' The value of patient contact shielding has minimized the low risk of exposure [7]. The correct definition of radiation safety is inverse square law [8]. '' it was recommended that occupational should undergo education and safety training after qualification [9]. '' reduction the hereditary risk by gonad shield [10]. ''staff working in radiation wards should have adequate knowledge of the risk and safety measures [11]. The current study reveals that, currently, radiographers' practices are unsatisfactory in regard to reducing radiation exposure for patients and themselves. Thus, a systematic and harmonized approach should be initiated in the form of corrective actions to ensure that radiation protection measures and standards [12]. The measurement of the occupational radiation dose plays vital role in personal protection [13]. Radiographers must take practical steps to protect patient, staff and themselves. In India, there are provisions in RPR 2004 to impose penalty actions, such as suspension or withdrawal of license, fine or imprisonment, or both, against the contravener of the said act, rule and safety code (RPR 2004, AERB 2016). In addition, AERB has a system of regulatory inspection of the facilities to find out the compliance status of the regulatory requirements. This inspection is based on the AERB safety manual, SM G-3, whose conceptual framework reflects the International Atomic Energy Agency (IAEA) inspection model (IAEA 2007, AERB 2014). The AERB adopts a graded approach to enforcement actions that are commensurate with the possible effects of regulatory non-compliance found in the facilities during the inspection. Such actions include a written directive or warning, shut down of the facilities, modification, suspension or withdrawal of license, and imposing penalty actions. [14]. The level of awareness is critical to reduction the radiation hazard [15].

The TLD Badge is a frequently used radiation monitoring tool in radiology, although most professionals choose not to wear it out of ignorance.

perspective on the hazards associated with radiation safety at work. Another issue is the dearth of suitable and qualified professionals.

c‘The professional capabilities of radiographer include several skills like teamwork skill, risk management, knowledge, professionalism, communication skills, safety and critical thinking skills. ‘A majority have neither a national regulatory framework for radiation safety nor a regulatory body. Most of developing countries have a shortage of qualified radiation protection experts, also a lack of formal education and training. The value of patient contact shielding has minimized the low risk of exposure. The correct definition of radiation safety is inverse square law. it was recommended that occupational should undergo education and safety training after qualification. reduction the hereditary risk by gonad shield. staff working in radiation wards should have adequate knowledge of the risk and safety measures. The current study reveals that, currently, radiographers’ practices are unsatisfactory in regard to reducing radiation exposure for patients and themselves. Thus, a systematic and harmonized approach should be initiated in the form of corrective actions to ensure that radiation protection measures and standards. The measurement of the occupational radiation dose plays vital role in personal protection. Radiographers must take practical steps to protect patient, staff and themselves. In India, there are provisions in RPR 2004 to impose penalty actions, such as suspension or withdrawal of license, fine or imprisonment, or both, against the contravener of the said act, rule and safety code (RPR 2004, AERB 2016). In addition, AERB has a system of regulatory inspection of the facilities to find out the compliance status of the regulatory requirements. This inspection is based on the AERB safety manual, whose conceptual framework reflects the IAEA inspection model (IAEA 2007, AERB 2014). The AERB adopts a graded approach to enforcement actions that are commensurate with the possible effects of regulatory non-compliance found in the facilities during the inspection. Such actions include a written directive or warning, shut down of the facilities, modification, suspension or withdrawal of license, and imposing penalty actions. The level of awareness is critical to reduction the radiation hazard.

1.1 The Dose Measurement Devices

1.1.1 Gas-Filled Detectors

The gas-filled detector is the simplest detector, compared to a scintillator detector or a semiconductor detector. This type of detector consists of a metallic cylinder, or one made of

other materials such as plastic, contains an electrode filled with inert gas as the medium and is connected to the pure capacitive load or an electrical circuit with a power supply. resistor, and a signal. In the event that an incident ionizing radiation enters the medium; it ionizes the inert gas and produces ion-free electron pairs which are later subjected to the electric field. While the positive ion moves towards the surface of the cylinder, the free electron moves towards the electrode and into the electric circuit, generating an electric pulse or count before it returns to the metallic cylinder and recombines with the positive ion and becomes neutral again. There are three types of Gas-Filled Detectors—an ionization chamber, a proportional counter, and a Geiger-Muller Counter.

(Gas field Detector)

1.1.2 Ionization Chamber

Anionization Chamber is the simplest form of a gas filled detector that measures the exposure rate of X-ray and gamma radiation and the dose absorbed via the application of the Bragg-Gray principle, operating at a low voltage that does not induce an avalanche of electrons and does not have a dead time issue. An ionization Chamber can detect alpha particles and beta particles with the application of thin window. Applications that utilize ionization chambers include radiation survey instruments, a radiation source calibrator, and the remote sensing of ionization.

(Ionization Chamber)

1.1.3 Proportional Counter

The work in states that the radial electric field between the cathode and the anode is generated by applying a positive high voltage to the anode, higher than the ionization chamber to induce the gas amplification phenomenon, which is the acceleration of free electrons from the initial ionization in a strong electric field inducing Townsend avalanche. This secondary type of ionization occurs at the threshold field of the order. The proportionality between the size of the output pulse and the total loss of energy as a result of the incident radiation defines the proportional counter, and is reliable for alpha and beta discrimination and used as a soft X-ray spectrometer for contamination screening as well as for neutron detection

(Proportional Counter)

1.1.4 Geiger-Muller Detector

The Geiger-Muller (GM) tube follows the same mechanism as a proportional counter by inducing a Townsend avalanche, but the gas amplification caused by a single avalanche is higher. The de-excitation of secondary free electrons releases an ultraviolet photon with sufficient energy to cause another avalanche originating from the gas or even the tube wall, and an uncontrolled chain avalanche occurs throughout the entire volume of gas in the cylinder. This entire process takes between 200 s–400 s to complete. During this time, the Geiger-Muller detector is considered to be dead, and incapable of detecting further nuclear particles. Adding alcohol, for example 10% ethanol, inside the gaseous tube may absorb the excess energy in the form of vibrational and rotational energy. Thus, it helps to reduce the dead time of the counter before it is able to count again. Since a low energetic particle can cause an avalanche across the entire chamber, the Geiger-Muller counter cannot differentiate the energy of the incident particles based on the pulse size for selective energy counting. Nonetheless, the Geiger-Muller counter is a reliable instrument that can be used to detect the presence of charged particles, neutrons, and photons.

(Geiger-Muller Detector)

1.1.5 Scintillation Detector

Scintillation is the property of a material medium that when a charged particle enters, it absorbs its energy and leads to the emission of light. There are two types of scintillation, the first is counter—organic scintillation, such as anthracene and stilbene and the second is inorganic crystal scintillators such as lanthanum bromide, sodium iodide and zinc sulfide. The ultraviolet light formed in the scintillator focuses on a photocathode, thereby inducing a photoelectric effect, and later hits a series of y nodes with a different potential difference that will undergo amplification in the photomultiplier tube. The collection of the electrons is interpreted by a pulse amplifier.

1.1.6 Semiconductor Detector

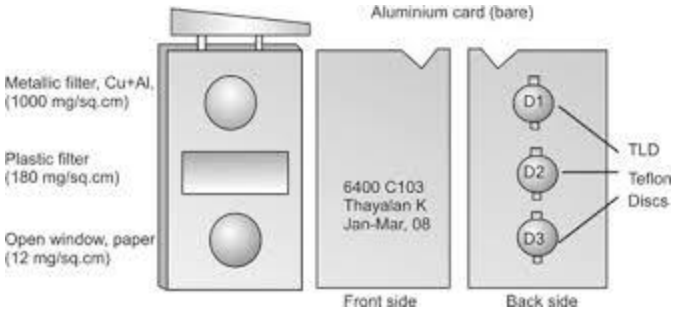
A semiconductor detector is an alternative to gas-filled and scintillation detectors. A compact detector, with a solid density of 1000 times greater than gas, can provide more carrier information for a given incident radiation event than is possible compared to other types of the detector. When sing a PN junction diode doped with silicon, germanium, diamond, or cadmium , the incident radiation enters the depletion region, causing the thermal excitation of the electron (~3 eV) from a valance band to a conduction band, creating electron-hole pairs in a reverse bias configuration. Through the collection electron-hole pairs, a detection signal is formed. Since the thermal excitation of an electron is low, a semiconductor detector can provide enhanced energy resolution and is used for general charged particle spectroscopy, alpha particle spectroscopy, X-

ray spectroscopy, gamma-ray, and personnel monitoring. Unfortunately, this excellent detector is susceptible to performance degradation from radiation-induced damage.

(Semiconductor Detector)

1.1.7 Application of Thermo luminescent dosimter (TLD) Badge

Radiation is widely used in the medical science for variety of the purpose such as diagnostic as well therapeutic purpose also. Advancement of technology in the medicine also increases the radiation exposure to the public as well radiation professionals. Radiation monitoring and keeping their record is a part of slandered radiology practice and it is also useful for future references in case of any radiation induced problems noted in the radiation professionals. There are variety of the devices is available to monitor the radiation dose for personnel as well for a particular area. TLD Badge is most usable radiation monitoring device in the radiology department by radiation professional including doctors and technologist. Wearing of TLD Badge is a very big issue due to lack of awareness about, how to use, how to store! Etc. most of the time it also observed that, radiation professional avoids wearing TLD Badge without any explanation. TLD Badge do not provide any protection from radiation, it just measures the radiation dose.


Aluminium card (bare)
Metallic filter, Cu+Al,
(1000 mg/sq.cm)
Plastic filter
(180 mg/sq.cm)
Open window, paper
(12 mg/sq.cm)
6400 C103
Thayalan K
Jan-Mar, 08
D1
D2
D3
TLD
Teflon
Discs
Front side
Back side

Proper ways of using TLDs
in Diagnostic Radiology

टीएलडी का प्रयोग करने का
उचित तरीका

RADIATION
TLD
MONITOR
035302-0000
CONTROL
Apr-Jun 2016
VARTTEC

JAN
APR
JUL
OCT

1.2 Radiation Protection

1.2.1 The International Commission on Radiological Protection (ICRP)

The International Commission on Radiological Protection is an independent, international, non-governmental organization, with the mission to protect people, animals, and the environment from the harmful effects of ionizing radiation. International System of Radiological Protection has been developed by ICRP based on the current understanding of the science of radiation exposures and effects, and value judgements. These value judgements take into account societal expectations, ethics, and experience gained in application of the system.

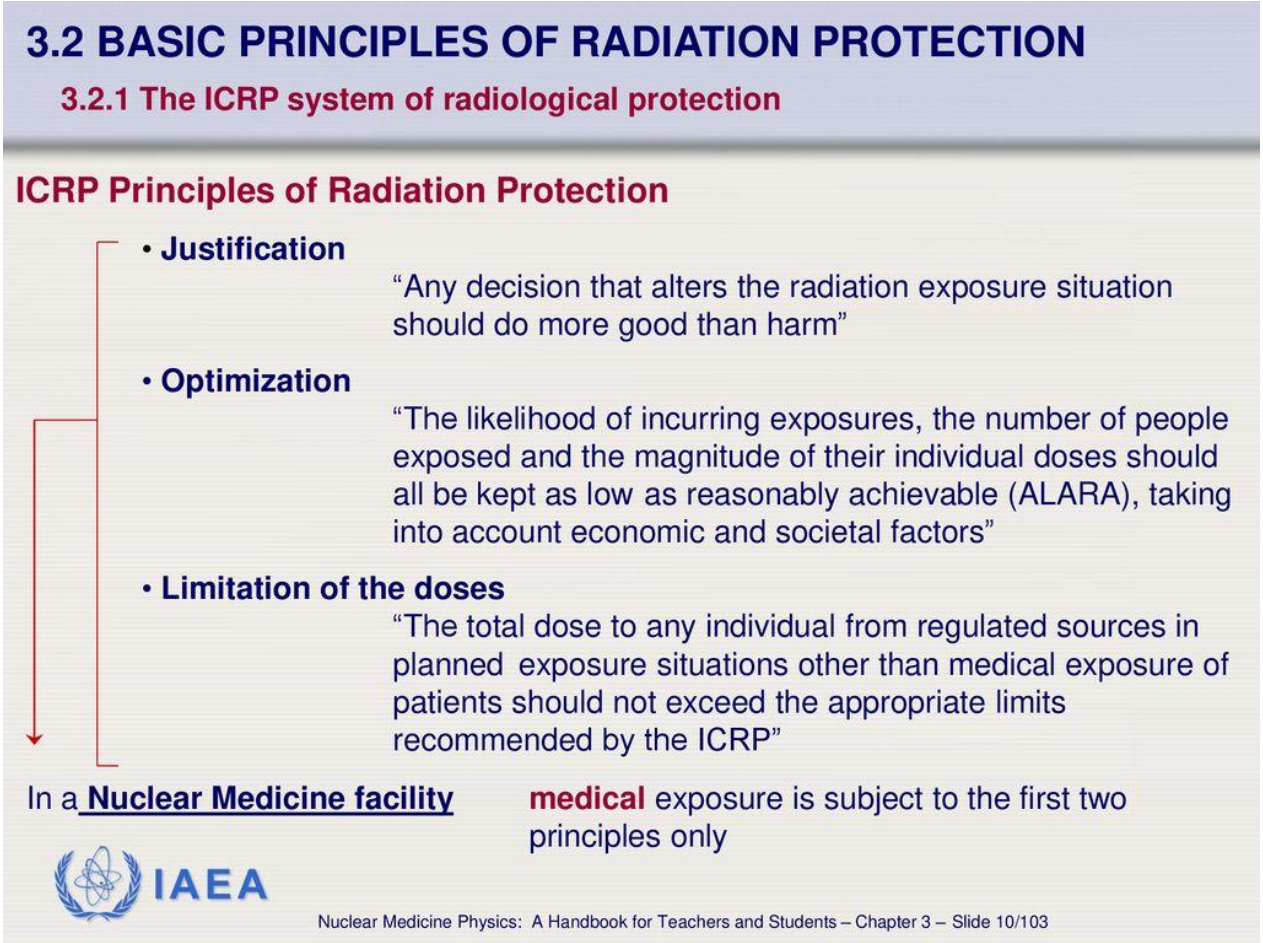

3.2 BASIC PRINCIPLES OF RADIATION PROTECTION
3.2.1 The ICRP system of radiological protection
ICRP Principles of Radiation Protection
• Justification
"Any decision that alters the radiation exposure situation should do more good than harm"
• Optimization
"The likelihood of incurring exposures, the number of people exposed and the magnitude of their individual doses should all be kept as low as reasonably achievable (ALARA), taking into account economic and societal factors"
• Limitation of the doses
"The total dose to any individual from regulated sources in planned exposure situations other than medical exposure of patients should not exceed the appropriate limits recommended by the ICRP"
In a Nuclear Medicine facility
medical exposure is subject to the first two principles only
IAEA
Nuclear Medicine Physics: A Handbook for Teachers and Students – Chapter 3 – Slide 10/103

Figure 1 The international commission on radiological protection (ICRP)

1.2.2 Atomic energy regulatory board (AERB)

Over the decade, there has been an accelerated growth in the application of ionising radiation technologies in the fields of medicine, industry and basic research in India. These applications have been accruing huge societal benefits, in terms of cancer treatment, diagnosis and industrial uses such as non-destructive testing, gauging and in food processing applications etc. However, the ionising radiation has certain radiological hazards associated with handling of radiation sources. The radiological hazards has potential to cause severe injury or environmental contamination unless handled safely. Therefore, the radioactive sources and radiation generators are required to be handled safely throughout their life cycle to prevent any undue risk to health and environment. In view of the above, radiation facilities are required to be regulated for ensuring that the use of ionising radiation does not cause undue risk to health and the environment. The Radiological Safety review and Regulation of such facilities using ionising radiation in India are carried out by Atomic Energy Regulatory Board (AERB). It is a statutory requirement, in accordance with the Atomic Energy (Radiation Protection) Rules, 2004 issued under Atomic Energy Act 1962, to obtain a requisite License from AERB, which is issued after ensuring overall safety in handling of radiation sources.

Figure 2 Atomic energy regulatory board (AERB)

Type of equipment:
Model Name:
Licence No.

X-RAY EXAMINATION IS GOING ON INSIDE, DO NOT ENTER

PLEASE WAIT FOR YOUR TURN

DO NOT STAY INSIDE X-RAY ROOM, IF REQUIRED TO ASSIST THE PATIENT, INSIST FOR PROTECTIVE APRON!

Similar display shall be prepared in local/regional language

Format of warning sign to be pated outside medical diagnostic x-ray installation

PASTE COPY OF AERB LICENCE HERE

To be printed in appropriate size

The Atomic Energy Regulatory Board(AERB) was constituted on 15 November 1983 by the President of India by exercising the powers conferred by Section 27 of the Atomic Energy Act, 1962 to carry out certain regulatory and safety functions under the Act. AERB has recommended Radiological protection principles as:

Justification

No practice or source within the practice should be authorized unless the practice produces sufficient benefit to the exposed individuals or to society to offset the radiation harm that it might cause; that is: unless the practice is justified, taking into account social, economic, and other relevant factors

Optimization (ALARA)

All living things in this universe are exposed to ionizing radiation from background radiation and man-made radiation sources. Ionizing radiation may cause somatic or genetic changes in the exposed person hence the doses to the occupational workers shall be kept As Low As Reasonably Achievable (ALARA) and doses to patients shall be optimized. Suitable control measures shall be employed to minimize radiation exposure so that maximum benefits are derived with minimum radiological risk.

Dose Limitations

(Never exceed Dose Limits) The normal exposure of individuals resulting from all relevant practices should be subject to dose limits to ensure that no individual is exposed to a risk that is judged to be unacceptable.

Time

- Exposure from radiation sources is directly proportional to the time
- Reduce the period of radiation exposure to reduce the dose received from a source.

Distance

- Increase distance from source to decrease exposure rate.
- I1 d1 2 = I2 d 2 2 (Inverse-square law)
- Double the distance from the source; dose-rate falls to ¼ the original value.
- Halve the distance from the source; dose-rate increase to 4 times the original value.
- More the distance from the source -Lesser the radiation

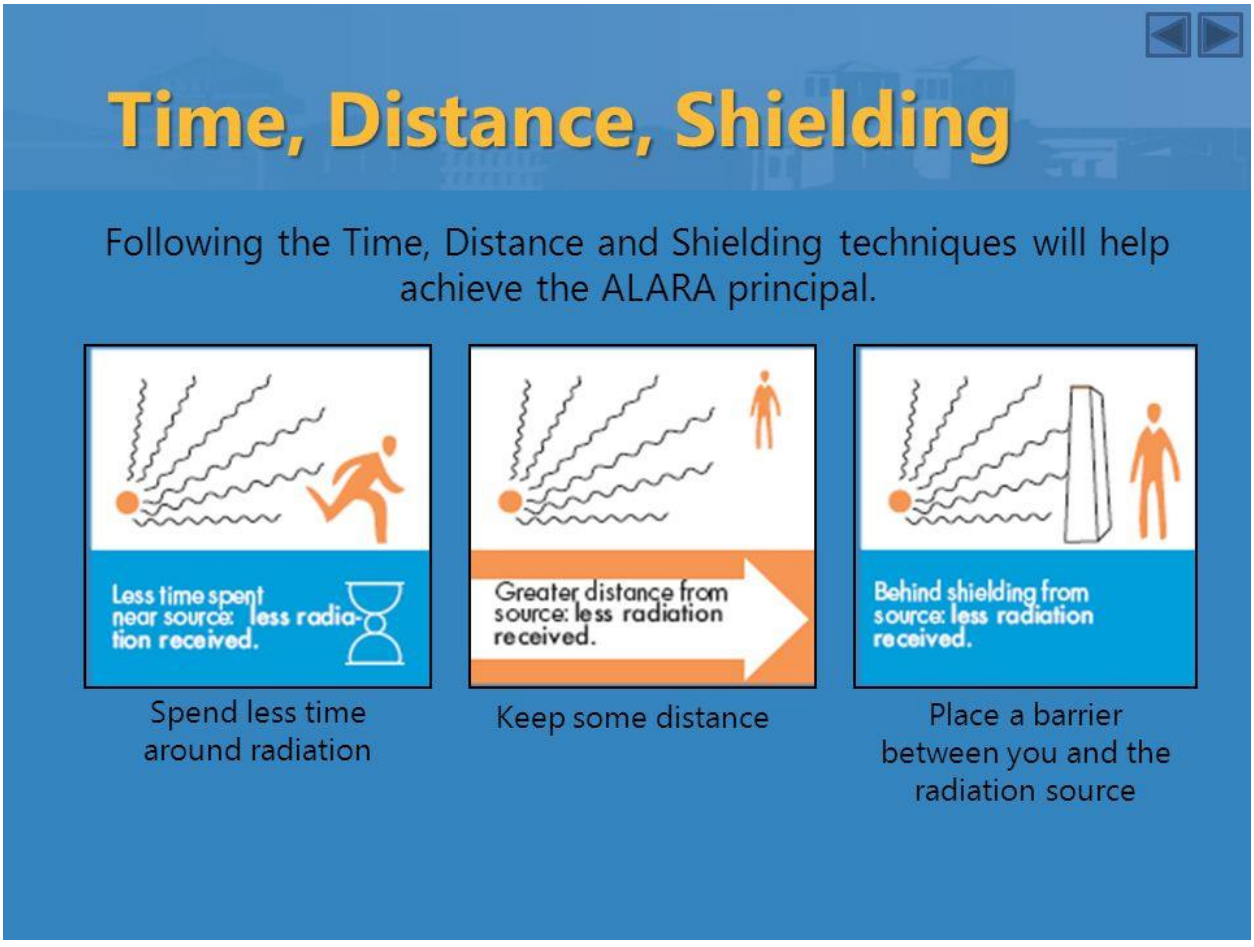
Shielding

- Use an appropriate shielding material or protection devices
- Shielding reduces exposure rate:

DOSE LIMITS

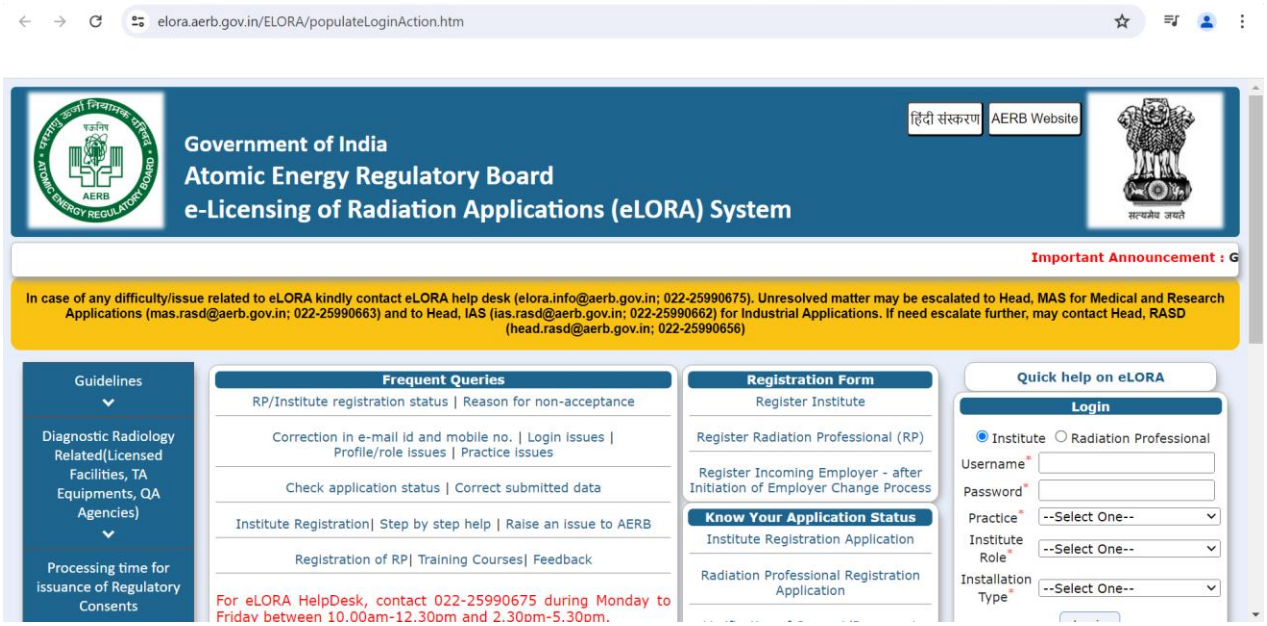
Part of the body	Occupational Exposure	Public Exposure
Whole body (Effective dose)	20 mSv/year averaged over 5 consecutive years; 30 mSv in any single year	1 mSv/y
Lens of eyes (Equivalent dose)	150 mSv in a year	15 mSv/y
Skin (Equivalent dose)	500 mSv in a year	50 mSv/y
Extremities (Hands and Feet) Equivalent dose	500 mSv in a year	-

For pregnant radiation workers, after declaration of pregnancy 1 mSv on the embryo/fetus should not exceed


Time, Distance, Shielding
Following the Time, Distance and Shielding techniques will help achieve the ALARA principal.
Less time spent near source: less radiation received.
Spend less time around radiation
Greater distance from source: less radiation received.
Keep some distance
Behind shielding from source: less radiation received.
Place a barrier between you and the radiation source

1.2.3 Elora

In order to meet the challenge AERB took initiative of implementing a state of art e-Governance system, eLORA (e-Licensing of Radiation Applications) through automation of regulatory processes associated with the use of ionizing radiation in India 2014. eLORA is a web-based I&CT (Information and Communication Technology) application establishing direct communication channel between AERB and its stakeholders for exchange of information and communication transaction for delivering its regulatory services as well as for achieving higher efficiency, reliability and transparency in dealings. The eLORA system is designed to automate the comprehensive business processes of radiological application regulations targeted to large number of facilities involved in use of ionizing radiation as well as radiation workers working with them for safe service. The components of eLORA are chosen to achieve Business Solution with Security, Performance, Availability, Scalability, Manageability and Maintainability. The infrastructure of eLORA system is based on virtualization technology which has helped in achieving cost effectiveness at the investment level and further during operations at the data Centre.


elora.aerb.gov.in/ELORA/populateLoginAction.htm
Government of India
Atomic Energy Regulatory Board
e-Licensing of Radiation Applications (eLORA) System
हिंदी संस्करण
AERB Website
Important Announcement : G
In case of any difficulty/issue related to eLORA kindly contact eLORA help desk (elora.info@aerb.gov.in; 022-25990675). Unresolved matter may be escalated to Head, MAS for Medical and Research Applications (mas.rasd@aerb.gov.in; 022-25990663) and to Head, IAS (ias.rasd@aerb.gov.in; 022-25990662) for Industrial Applications. If need escalate further, may contact Head, RASD (head.rasd@aerb.gov.in; 022-25990656)
Guidelines
Diagnostic Radiology Related(Licensed Facilities, TA Equipments, QA Agencies)
Processing time for issuance of Regulatory Consents
Frequent Queries
RP/Institute registration status | Reason for non-acceptance
Correction in e-mail id and mobile no. | Login issues | Profile/role issues | Practice issues
Check application status | Correct submitted data
Institute Registration| Step by step help | Raise an issue to AERB
Registration of RP| Training Courses| Feedback
For eLORA HelpDesk, contact 022-25990675 during Monday to Friday between 10.00am-12.30pm and 2.30pm-5.30pm.
Registration Form
Register Institute
Register Radiation Professional (RP)
Register Incoming Employer - after Initiation of Employer Change Process
Know Your Application Status
Institute Registration Application
Radiation Professional Registration Application
Quick help on eLORA
Login
Institute
Radiation Professional
Username*
Password*
Practice*
--Select One--
Institute Role*
--Select One--
Installation Type*
--Select One--

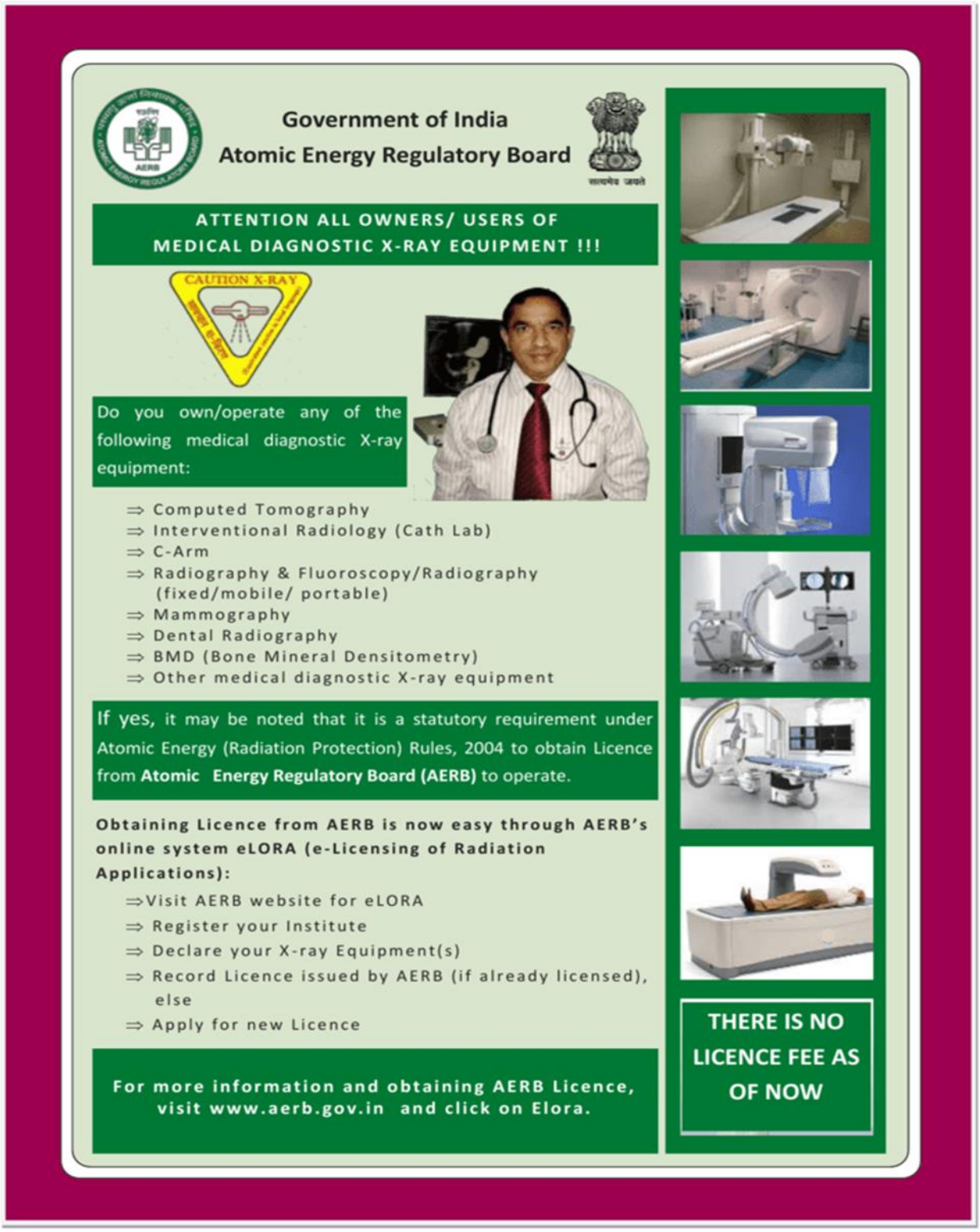

Government of India
Atomic Energy Regulatory Board
ATTENTION ALL OWNERS/ USERS OF MEDICAL DIAGNOSTIC X-RAY EQUIPMENT !!!
CAUTION X-RAY
Do you own/operate any of the following medical diagnostic X-ray equipment:
⇒ Computed Tomography
⇒ Interventional Radiology (Cath Lab)
⇒ C-Arm
⇒ Radiography & Fluoroscopy/Radiography (fixed/mobile/ portable)
⇒ Mammography
⇒ Dental Radiography
⇒ BMD (Bone Mineral Densitometry)
⇒ Other medical diagnostic X-ray equipment
If yes, it may be noted that it is a statutory requirement under Atomic Energy (Radiation Protection) Rules, 2004 to obtain Licence from Atomic Energy Regulatory Board (AERB) to operate.
Obtaining Licence from AERB is now easy through AERB's online system eLORA (e-Licensing of Radiation Applications):
⇒Visit AERB website for eLORA
⇒ Register your Institute
⇒ Declare your X-ray Equipment(s)
⇒ Record Licence issued by AERB (if already licensed), else
⇒ Apply for new Licence
For more information and obtaining AERB Licence, visit www.aerb.gov.in and click on Elora.
THERE IS NO LICENCE FEE AS OF NOW

Figure 2 e-Licensing of radiation application (ELORA)

1.4 Radiation Effects

1.4.1 Somatic

Somatic effects are the outcomes of radiation exposure that occur when living things, including people, sustain biologic harm. The consequences are categorized as either of the following, depending on how long it takes from the time of radiation exposure to the onset of radiation damage symptoms:

1. early impacts on the body
2. consequences on the body later. Previously known as non-stochastic somatic effects, they are known as deterministic somatic effects.

1.4.2 Genetic (Hereditary) Damage Factors

Ionizing radiation may harm genetic material (mutations) in gonads or germ cells, which can result in genetically caused disorders (hereditary abnormalities). Malformations, metabolic issues, immunological deficits, etc. might arise from them.

1.5 Need for Study

To evaluate the awareness of RSO and Technicians regarding AERB compliances in hospital and imaging centers. Because when I studied all related article there is gap between aerb compliances and awareness of concern staff.

2 AIM & OBJECTIVE

AIM:

A Study to Check the Radiation Safety and Standard Operational Compliances Guidelines by AERB in Radiodiagnosis Department of Western Uttar Pradesh Hospitals, India**.**

OBJECTIVE

1. To analyze the knowledge of RSO/Technicians about Elora compliances.
2. To analyze the knowledge of RSO/Technicians about the safety devices compliances.
3. To analyze the knowledge of RSO/Technicians in general radiation safety compliances especially in rural areas.

HYPOTHESIS

- H1= Knowledge of RSO/Technicians about Elora compliances.
- H2= Knowledge of RSO/Technicians about the safety devices compliances.
- H3= Knowledge of RSO/Technicians in general radiation safety compliances, especially in rural areas.

2 REVIEWS OF LITERATURE

1.Nima Hamzian, Saeed Asadian, Hassan Zarghani - 2022. A Study of Radiation Protection Standards Compliance in Hospital Radiographic Departments in Iran.

The purpose of this research was to evaluate how well Iranian hospital diagnostic radiology departments were currently adhering to conventional radiation safety requirements. Using a checklist, descriptive research examined the typical radiation protection requirements in locations, including the physical layout of the control and waiting areas, radiography equipment, and shielding facilities. The radiation safety personnel received the checklists after 84 hospitals in 51 cities throughout Iran were chosen at random. To establish a baseline for evaluating their facilities, radiation protection officers at hospitals with several radiography rooms were requested to fill out a checklist pertaining to the room with the highest workload. Ultimately, every checklist was examined by the writers. The findings show that the average adherence to radiation safety regulations. It is highly advised that the radiation protection authority bodies examine more restrictive regulations and recommendations for the radiation protection program in addition to regularly monitoring and visiting radiation medical facilities. It is also recommended that radiation centers and more thorough investigations be conducted to ensure compliance with radiation safety standard practices.

2-Prashant Kumar Jha1, Himal Rai2, Goutam Suklabaidya3, Subhamoy Satpathy-2022 Awareness Level about TLD Badge among Radiology Students.

In the field of medicine, radiation is often used for both therapeutic and diagnostic purposes.

The public's and radiation professionals' exposure to radiation is increasing as medical technology advances. As part of slandered radiography practice, radiation monitoring and maintaining records are important for future reference in the event that radiation-related issues are observed in radiation professionals. A range of instruments are available to track the radiation exposure of individuals in a specific location. The TLD Badge is the most practical radiation monitoring tool for radiation professionals, such as technologists and physicians, in the radiology department. Because of ignorance, wearing a TLD badge is a major problem. It has been noted that there is very careless and irregular usage of TLD Badges in radiology practices; even after receiving one, radiology professionals do not wear it while on the job. A crucial component of radiology practice is the TLD Badge. However, the majority of professionals

choose not to wear the emblem out of ignorance. to find out how well-informed and conscious radiology students are about the TLD Badge generally. This paper summarizes the use of a TLD Badge as a crucial component of radiology practice. However, the majority of professionals choose not to wear the emblem out of ignorance. It offers no radiation protection at all. The radiation worker has to be made more conscious of wearing the badge. It may help raise awareness of health issues and enhance radiology practice.

3.Armin Ansari1,4, Kyle Kleinhans2, John D Boice3-2022

Potential health effects of low dose radiation and what it means to the practice of radiation protection.

The ways in which ionizing radiation interacts with live tissue are well understood. We can reasonably estimate the probable acute health consequences for those exposed to high radiation doses. This is excellent news since there is a very little chance that these exposures will have a negative impact on one's health. It is the distinction between very low, very low, and maybe zero danger; yet, we are unable to quantify how low that chance is. These restrictions feed the continuing discussion. While we focus our efforts on public outreach, it's equally critical to provide radiation protection practitioners regular updates on the status of research and the fundamental concepts behind the radiation protection system they use. Such an endeavor might have two possible advantages: (1) radiation protection specialists will become more resilient to the false information they are exposed to on a daily basis, and (2) they will be better able to interact with their stakeholders. We may be proud of the strong radiation protection system we have. This method may be strengthened even more with a strong public relations strategy and a succinct communications plan.

4. Maajid Mohi Ud Din Malik1., Mohd. Arfat2* and Alok Kumar-2022

A questionnaire survey of radiation hazards and protection among medical and imaging technology students.

On the other hand, the participants had little knowledge about safe dosages and how to utilize TLD as a radiation exposure monitor during the radiography test. This poses a severe risk because they can get used to the difficulties associated with workplace radiation safety. Although the majority of participants in this research showed a decent understanding of radiation dangers

and how to protect themselves even in the face of inadequate radiation protection measures, radiation exposure and the incidence of aberrant clinical conditions were still found to be below average. To guarantee adherence to radiation safety rules, students and occupationally exposed health professionals must get periodic training and frequent monitoring. In order to reduce radiation hazards and mishaps, it's also critical to keep radiology technicians and students informed about new advancements and procedures. In order to provide a safer imaging environment, radiology technicians must also follow the rules set out by several national and international organizations.

5. F. Panahi1, M. Mohammadi2, F. Naserpour1, N. Hassanpour1, M. Gholami1*-2022

Entrance dose determination and effective dose calculation in chest and skull radiographies: an experimental and computational study.

In the majority of nations, ionizing radiation is widely used as the most important man-made source for medical diagnostics. In this research, we looked at the radiation exposure associated with routine radiography exams of the skull and chest. Reducing the effective dosage may be accomplished with the use of elements like high-speed films, modern equipment, and performance. Furthermore, retraining radiology staff members is essential to getting the finest ALARA with the best medical pictures. the annual amount of radiographs as well as any extra cancer brought on by the radiographic exams of the skull and chest. Consequently, the cumulative effective dosage is not important since only the dose of these tests is taken into account; if the dose of examinations with larger absorbed doses, such CT scans, fluoroscopy, angiography, etc. If included with them, its value will rise dramatically. Its value will increase significantly if it is added to them. This confirms the need to continue such studies and to extend them to other X-ray diagnostic methods.

6. Kanchan Sarga Nyaichyai, Medical Physicist, Clinical Oncology Department, NAMS Bir Hospital, Kathmandu, Nepal-2022

The goal of occupational radiation safety and health programs is to promote a safe work environment. And conduct a radiation safety survey in Kathmandu area.

It was noted that every contributor mentioned Nepal's lack of power and any kind of regulation. State authorities must create and maintain federal frameworks, laws, policies, and programs

pertaining to occupational safety and health, which must include measures to provide occupational health services to all employees. Thorough study is desperately needed in the areas of radiation health and safety as well as other services that apply to all of Nepal and where radiation is being utilized for constructive reasons.

7. Toru Akebia＊, Ryutaro Matsugakib, and Toshiro Ono -2022

Survey of work-related musculoskeletal disorders of Radiological technologists (RTs) often perform tasks that involve high physical loads, such as equipment handling and patient positioning.

According to the current findings of the multiple logistic regression study, RTs' WMSD- Work-related musculoskeletal disorders- may be impacted by whether or not they are wearing lead aprons.In addition to traditional radiological diagnostic and therapeutic treatments, innovative techniques including high-risk radiation-exposure interventional radiology (IVR) have been introduced in recent years. The fact that we conducted a survey of RTs' real work environments and addressed a specific topic on the connection between WMSDs and lead aprons makes this research strong. The study's findings demonstrate how important lead aprons are in terms of physical components for RTs' occupational health management. This research is not without limits, however. Initially, there were not many participants and a poor questionnaire response rate. Although the cause of this is unknown, it's conceivable that prospective participants were not fully aware of the questionnaire.

An increase in the number of RTs surveyed will be required. Second, the study used three approximative categories of lead apron usage to conduct a semi-quantitative analysis.

8. elizabeth m davies, msc, andrew j bridges, msc and emma ml chung-2021

Does radiology require informed consent for radiation risk.

It is suggested that requiring informed permission before exposing someone to medical radiation is the only position that complies with both ethical and legal obligations for radiation protection.

While getting formal permission isn't always essential, it is vital to come to an agreement on a workable graded consent system for radiology. Potential radiation dangers should be mentioned throughout the consent process when written permission is requested for other purposes. Although obstacles to the implementation of informed consent procedures must be recognized

and addressed, they cannot be used as justification for the absence of informed consent requirements. Future research should focus on whether patients believe they should be made aware of uncertainty and how this influences how they receive information about the risk.

under the event that permission is necessary, this information may not be given under the following three circumstances:

• Should the data be deemed "detrimental to the patient's health"

• The patient cannot offer legitimate permission, notwithstanding the urgency of the treatment.

• The information is refused to be given to the patient.

9. Nima Hamzian1 , Saeid Afereydoon2, Mahdi Ghorbani3* , Seyed Mohammad Jalil Abrisham4, Zahra Roozmand5, Sepideh Abdollahi Dehkordi6, Morteza Sepehr Javan7, Mohammad Reza Deevband-2021

Equivalent Dose and Risk of Exposure Induced Cancer Death of Different Organs due to Various Image Techniques of Imaging System.

Different imaging system methodologies resulted in varying equivalent doses and risks of radiation-induced cancer mortality in different organs. Imaging System to the low radiation dosage that the body receives during exposure to imaging in various imaging techniques and perspectives, the danger of exposure-induced cancer mortality for various body organs is minimal, as is the equivalent dose.

10. Zinat Mohebbi1, Roya Ershadpoor2, Mohsen Ostovari3, Mahnaz Rakhshan1-2021

The radiation protection capability of operating room.

The C-arm, also known as the fluoroscope, is the most often used radiation-generating tool in the operating room. It is used in many different types of procedures, including angiography, neurosurgery, orthopedics, and urology. Reducing the hazards of ionizing radiation is largely dependent on nurses working in the operating room being aware of and adhering to radiation protective standards. Because radiation is used in operating rooms more and more, it is crucial that those working in them be able to protect themselves from radiation. In this sense, learning about and comprehending this issue may be aided by the development and psychometrics of a reliable and relevant instrument. In the current research, an Iranian-designed questionnaire was used to assess operating room nurses' proficiency in radiation protection. The study's findings

demonstrate that the questionnaire's psychometric qualities are adequate. Using this psychometric assessment may help build plans to address issues related to radiation safety in operating rooms.

11. jenia vassileva, phd and ola Holmberg-2021 Radiation protection perspective to recurrent medical imaging: what is known and what more is needed.

Some of these include increased availability of dose-saving imaging technologies; enhanced imaging protocols and appropriateness processes; customized optimization based on the clinical state and behavior of the patient; increased use of automated exposure monitoring systems with an integrated option for tracking individual exposure in standardized patient-specific risk metrics; and enhanced communication and training. The amalgamation of exposure history and clinical data will provide enhanced comprehension of individual radiosensitivity and low-dose radiation hazards. High individual doses and repeated imaging will provide challenges for the radiation protection framework. The clinical viewpoint is enhanced by the radiation protection perspective, and the risk-benefit analysis must take into consideration the patient's unique requirements, clinical history, and any incidental and long-term benefits and dangers. A step in the direction of patient-centered healthcare is this. It is emphasized that reduced dosage imaging modalities and procedures are necessary, along with enhanced imaging tactics, an appropriateness approach, and optimization that is relevant to the patient's habits and clinical situation. enhanced approaches for monitoring patient exposure in support of the proper and optimum use of radiological imaging, as well as for enhanced estimation of individual radiation risks, are made possible by technology advancements and data science. If appropriately used, this information would complement the clinical decision-making process that takes into consideration the patient's unique requirements, clinical history, and any incidental and long-term benefits and dangers. This is a start in the direction of patient-centered healthcare.

12. Adhikari, Kanchan P.; Boersma, Hielke Freerk; Coates, Roger; Coulor, Whitney; Gallego, Eduardo; Omrane, Latifa Ben; Suarez, Rodolfo Cruz; Tsegmed, Uranchimeg-2021 Radiation protection infrastructure challenge in developing countries.

The International Radiation Protection Association Congress included a special session aimed at addressing the unique obstacles developing nations face when it comes to radiation protection

infrastructure. A special session of the International Radiation Protection Association Congress was devoted to discussing the particular challenges developing countries have in providing radiation protection infrastructure. Creating a national legislative framework that allows for a regulatory body with the requisite funding and independence, establishes an efficient system of licensing, inspections, and enforcement, and uses a graded approach in its regulatory procedures is a typical difficulty. There is little or sluggish progress made in many nations toward this crucial stage. The majority of developing nations lack sufficient human resources, particularly medical physicists with the necessary practical competences and specialists in radiation safety.

Along with a lack of (or inadequate) systems for the recognition or certification of professionals, there are often deficiencies in formal education and training programs. A dearth of national or regional professional groups might lead professional personnel to feel alone. Numerous nations report having insufficient funding for essential support functions including dosimetry and other measuring capabilities, as well as for maintenance and calibration. All staff members working in radiation protection often lack understanding of the significance of creating an efficient radiation safety culture, and they also often lack the skills and resources necessary to create improvement initiatives.

13. PETER HILES Glan Clwyd Hospital, Bodelwyddan, United Kingdom-2021 Contemporary issues in radiation protection in medical imaging.

The procedure of radiation safety starts with the justification of the diagnostic X-ray examination and ends with the direct application of radiation shielding onto a patient. In the past, shielding the gonads was the main use of touch shielding. Since then, however, this has broadened to encompass safeguarding additional organs like the thyroid and breast that are thought to be susceptible to cancer induction.3. It has also been used to limit fetal exposure while examining pregnant patients, and more recently, because of increased worries about the possibility of cumulative doses, it has been employed to limit exposure to eye lenses. Numerous technical advancements have resulted in considerable decreases in patient doses since the introduction of patient contact shielding, which may lessen the need for extra protection. The maxim "as low as reasonably achievable," or ALARA, sums up the primary goal of radiation protection with regard to patient exposure. The expected degree of dose or radiation risk reduction and the perceived relevance of that change are the main factors that influence the choice to employ or not utilize

patient contact shielding. Patient touch shielding is no longer as valuable and often has no impact on the already low risk of exposure-related damage.

14. Cristian Candela-Juana,*, Olivera Ciraj-Bjelacb, Marta Sans Mercec,d, J´ er´ emie Dabine, Dario Fajf,g, Aoife Gallagherh, Hugo de las Heras Galai, ˇ Zeljka Kneˇ zevi´ cj, Françoise Malchairk, l, Francesca De Montem, George Simantirakisn, Chrysoula Theodorakouo-2021 Use of out-of-field contact shielding on patients in medical imaging.

The current scientific evidence regarding two issues—the risks associated with X-ray exposure, which demonstrate that the benefit of shielding is minimal, and the potentially improper use of this shielding, which can impair image quality and/or interfere with the AEC—may be used to support this historic shift in patient management. Generally speaking, shielding should only be used in two situations: either it guarantees the patient and caregivers that they are suitably protected from potentially hazardous radiation effects, or it does not jeopardize the diagnostic work and procedure performance. Very few regulations specifically mandate the use of shielding in a given imaging modality, though they may regard it as a component of good radiological practice or a prerequisite for the availability of auxiliary or protective tools, without going into further detail about how they should be used. Documents that suggest out-of-field shielding, those that do not, and those that are vaguely worded all take somewhat different stances. Thus, to guarantee optimal and consistent practice, evidence-based agreement is still required.

15.Harrison, J. D., Balonov, M., Bochud, F., Martin, C. J., Menzel, H-G., Smith-Bindman, R., Ortiz-López, P., Simmonds, J. R., & Wakeford, R. -2021 The use of dose quantities in radiological protection.

The dose quantities that are used to define limits to avoid tissue responses and the dose criteria (limits, restrictions, reference levels) that improve protection from stochastic effects are fundamental to the radiological protection system. For these objectives, ICRP makes use of the absorbed dosage, equivalent dose, and effective dose as outlined in the 2007 Recommendations. The link between the effective dosage and stochastic hazards, namely the cancer risk, is a significant issue. Effective dosage may be used as a "approximate indicator of possible risk," according to ICRP (2021). This phrase was used to highlight the inherent uncertainties in risk estimate and to recognize that the doses being considered are often lower than the levels at which direct epidemiological reports of increased cancer cases are available. By establishing limitations

below the threshold dosages at which these effects manifest, tissue responses are managed. Rather than continuing with the existing method of using equivalent dosage, an intermediary step in the computation of effective dose, these limitations will be established in absorbed dose going forward. It is possible to stop using equivalent dosage as a protective amount, which would simplify the system. It will be necessary to take radiation weighting for tissue responses into account. Based on averages across all ages and genders, the tissue weighting parameters used to calculate the effective dosage are relative harm values. The data presented in this paper highlight the significant variations in cancer incidence and associated estimates of harm based on age at irradiation, with large variations in the age-dependent cancer risk for specific cancer sites between males and females. The use of population-, age-, and sex-averaged detriment values together with a single set of tissue weighting variables hides these disparities. The rationale for the present method has been that it offers a practical, equitable, and feasible system whereby dosage requirements are established and optimization is implemented for all employees and members of the public. Male and female human body phantoms are currently used to compute organ and tissue absorbed dosages for adults and children of different ages. Calculating the associated detriment and relative detriment values, as well as the effective dosage coefficients based on these values, would be a consistent method. As a final step, an average for all employees and the general public could be calculated, or dosage guidelines may be established using the range of effective dose coefficients and stated detriment values. This strategy would not have an impact on the actual implementation of the protection system as a whole, but it would make it easier to think through the best forms of protection for different population segments, such as young children's exposures. With a timeframe of around ten years, ICRP is now reviewing the radiological protection system in order to prepare its next set of essential recommendations.

16.MuhammadIkmalAhmad1, MohdHafiziAb. Rahim2, RosdiadeeNordin3, *, Faizal Mohamed1, Asma' Abu-Samah 3 andNorFadzilahAbdullah-2020 Ionizing Radiation Monitoring Technology at the Verge of Internet of Things.

The paper states that radon gas is the second leading cause of lung cancer, behind smoking. It is responsible for around 21,000 deaths annually from this illness. According to Dr. Michael Repacholi, coordinator of the World Health Organization's Radiation and Environmental Health

Unit, radon is the main contributor to ionizing radiation exposure. In several nations, it accounts for 50% of the public's exposure to naturally occurring sources of radiation. Hence, continuous radiation monitoring is needed to protect nearby inhabitants from serious health hazards. It is equally vital to investigate the impact of radiation on the environment. Radiation detection has been crucial in the nuclear industry. The advent of the Internet of Things (IoT) has revolutionized radiation monitoring by enhancing the safeguarding of the public and personnel from radiation exposure and proactively predicting various radiation hazards via advanced data analysis and prediction methodologies. Data in nuclear and radiation monitoring may be saved, analyzed, and used remotely for decision-making or other purposes. This study evaluated the growing use of IoT technology in different domains. The performance and technical functioning of the radiation sensor have been assessed and established. Researchers have explored the possible use of IoT in radiation monitoring, as well as the challenges that arise from the current limitations in the business. The integration of sensors with autonomous vehicles enables the safe and accurate collecting of radiation data. It is foreseeable that advancements in the Internet of Things will lead to the development of more sophisticated radiation sensors that provide enhanced efficiency and accuracy, while also being smaller, lighter, and more energy-efficient. This would facilitate the automation of the radiation monitoring industry, resulting in faster and more rapid decision-making to ensure the safety of individuals.

17. Said Soudjay1, 2, *, Vololoniaina Bernardine2, Ramanandraibe Marie Jeanne2, 4, Ramanantsizehena Georgette Vololona3, Raboanary Roland3, Randriamora Tiana Harimalala-2021 Application of Radiation Protection of Patients in Medical Diagnostic Radiology. Optimization of doses delivered to the patients is regulated in Madagascar.

In this research, we successfully determined the doses given to patients who had the four specified radiological examinations at the two hospitals in Fianarantsoa. However, it is necessary to effectively handle this information. It has been noted that the average doses given to the patients are below the reference values set by the International Atomic Energy Agency (IAEA). There has been a slight, albeit statistically insignificant increase in thoracic exams at the Tambavao University Hospital Center. The results indicate that these institutions have implemented radiation protection measures for patients in compliance with the regulatory plan dated January 2, 1998, which focuses on the proper disposal of radioactive waste and

safeguarding against the harmful effects of ionizing radiation. The findings, which were assessed based on the geometric and exposure criteria that affect dosage, show the feasibility and strong interest in conducting a larger-scale nationwide effort to monitor doses in radiology. This would allow for the creation of National Reference Laboratories (NRLs) that are specific to Malagasy practices, as well as the development of a system for regularly evaluating and improving these laboratories, and determining effective optimization methods.The objective of our research is to develop a digital radiological monitoring platform that enables real-time assessment of patient doses in the Madagascar area, using the findings from our study.

18. Cécile R. L. P. N. Jeukens*, Gerhard Kütterer, Pierre J. Kicken, Marij J. Frantzen, Jos M. A. van Engelshoven, Joachim E. Wildberger and Gerrit J. Kemerink-2020 As gonad shielding is currently under debate, this study evaluates the practice.

This article seeks to provide a comprehensive and in-depth review of the benefits and drawbacks of gonad shielding, spanning from its inception to the current day. Lead (Pb) has been the preferred material for shielding since the first X-ray investigations conducted by Röntgen. Regrettably, lead causes discoloration on hands and clothing, and the stains worsen with continuous use. To completely grasp the significance of gonad shielding in pelvic radiography, it is essential to have a clear understanding of the dose received by the ovaries and testes. The primary motivation for the reinstatement of gonad shielding in the 1950s was to minimize the risk of genetic harm. Minimizing radiation exposure in pelvic radiography mostly relies on the optimization of techniques and the use of state-of-the-art equipment. The use of gonadal shielding may significantly decrease the risk, adjusted for possible harm, to such a degree that, given the negative outcomes, it is justifiable to stop the practice. The evaluation of pelvic doses demonstrates that technology developments have effectively reduced the risks associated with radiation exposure. Although optimization had a role, its whole potential was never fully achieved. Today, with the use of a state-of-the-art and efficient X-ray equipment, it is now possible to safely stop employing gonad shielding for women. While males may have a little advantage, the possible adverse effects are likely to outweigh any benefits.

19. Salah Eldeen NG1 and Farouk SA-2020 Assessment of awareness and practice of ionizing radiation protection procedures among exposed health care workers.

Work-related ionizing radiation exposure occurs as a result of being exposed to radiation utilized

for medical treatments and diagnostic procedures. Ionizing radiation refers to a specific kind of energy that may be seen as electromagnetic waves or particles. The latest study findings suggest that professionals working in Radiology, Clinical Oncology, and Nuclear Medicine have a satisfactory comprehension of safety measures related to ionizing radiation. This study discovered that healthcare workers (including doctors, nurses, physicists, and technicians) have a rather good degree of understanding on safety measures. The study on Ionizing Radiation Protection 543 revealed that healthcare workers (HCWs) were insufficiently cautious and that workplace implementation of radiation safety measures was inadequate. These results need the implementation of an assessment system to ensure that healthcare workers (HCWs) possess a heightened degree of awareness, that training programs are kept up-to-date, that safety procedures are rigorously adhered to, and that all radiation protection equipment is readily accessible.

20. Mohammad Rasoul Tohidnia1, Azmoon far Rasool1, Amiri Fatemeh1,*, Seyed Ali Rahimi2, Amiri Neda3 and Sharafi Hosna4-2020 The evaluation of radiation protection principles observance in dental radiography centers.

Among the 103 dental clinics in Kermanshah province, 78 of them used intraoral radiography. A total of seventy-three private dentistry facilities, accounting for 93.6% of the sample, and five public dentistry centers, representing 6.4% of the sample, were included in this research. The objective of dental radiography is to get a high-resolution image of the oral and maxillofacial anatomy while minimizing the level of radiation exposure for the patient. Therefore, it is essential to consider increasing the use of X-ray diagnostic tools.
The objective of dental radiography is to get a high-resolution image of the oral and maxillofacial anatomy while minimizing the amount of radiation exposure to the patient. Therefore, it is essential to consider increasing the use of X-ray diagnostic tools as the next step.

21. Choonsik Lee-2020 Estimate effective dose for CT patients provides patients with unarguable benefit in modern medicine.

which, largely surpass the risks associated with adverse health effects. The International Commission on Radiological Protection (ICRP) coined the phrase "effective dose" to mainly address the management of protection against stochastic consequences, including cancer. This

dosimetric amount, adjusted for risk, enables the comparison of planned or received doses with dose limits, dosage limitations, and reference values, all represented in the same quantity. The radiation protection quantity has become the preferred choice among radiologists to describe medical radiation dose due to its ability to measure the cancer risk for the major radiosensitive organs throughout the patient's anatomy and its ease of retrieval from dose monitoring systems.The ICRP defines the effective dosage as the total of the equivalent doses in all specified tissues and organs of the body, taking into account their respective weights. The International Commission on Radiological Protection (ICRP) provides a list of tissue weighting factors. These variables describe the proportionate contribution of each tissue or organ to the overall health damage caused by uniform radiation exposure to the body. The list also includes the definition of these factors. The tissue weighting factors are not customized for specific individuals or subgroups, such as women or children, since they are calculated based on average age and gender. In order to establish the effective dose as stipulated by ICRP Publications, one must calculate the absorbed dosage for around thirty different organs and tissues, and apply tissue weighting factors to each. The most practical approach for determining the effective dose for CT patients is to use dose-length product (DLP) and conversion factors known as k-factors. This technique can be implemented by most CT dose reporting systems. The effective dose may be easily determined by multiplying the conversion factors with the DLP values that are readily available from CT scanners. Pre-determined conversion factors are generated by using Monte Carlo radiation transport simulation of CT x-rays alongside computational human phantoms. Several studies have reported various sets of conversion factors for DLP-to-effective dose. When comparing various research on CT dose, it is crucial to consider the many elements involved in establishing the conversion factors.

22. F. Bochuda, M.C. Cantoneb, K. Applegatec, M. Coffeyd, J. Damilakise, M. del Rosario Perezf, F. Faheyg, M. Jesudasanh, C. Kurihara-Saioi, B. Le Guenj, J. Maloned, M. Murphyk, L. Reidl, F. Zolzer-2020 Ethical aspects in the use of radiation in medicine update from ICRP.

Medicine has become a significant sector of government expenditure in several developed countries. This level of investment can only be achieved if the community perceives it as substantial and in alignment with ethical principles. Publication 138 introduced a specific set of ethical guidelines for the protection of individuals from radiation (ICRP, 2018). This article aims to provide information on the

ethical considerations related to patient radiological protection in the field of medical radiation treatment and diagnostics. The intended audience includes healthcare practitioners, patients, families, caregivers, the general public, and authorities. It is recommended to do a series of self-assessments based on the ICRP 2019 Proceedings to determine the level of compliance or non-compliance with a particular patient circumstance with six key ethical principles. This may be done using a simple tabular evaluation method. An instance of elderly exposure is provided as an illustrative example. The final report will use radiological imaging and therapy to tackle a wide range of practical situations often faced in the field of medicine. Each scenario will start with a credible situation, and the evaluation approach will aid the reader in identifying the relevant ethical concerns. This will provide the foundation for a more thorough examination of each situation. The final study will include other significant topics such as artificial intelligence, communication between patients and families, and education and training for health professionals.

23. Louis W.A. van Papendorp1 Farhana E. Suleman2 Heleen Hanekom1-2020

Fluoroscopic imaging is increasingly being used in modern orthopedic operating rooms, and orthopedic surgeons are also becoming more knowledgeable, informed, and skilled in radiation safety. Participants' historical exposure to radiation safety training sources may be assessed by checking several options on a question. The available alternatives were a radiation protection course, a lecture by a radiation safety specialist, discussions with colleagues, undergraduate teaching, online resources, no option, and others. Thorough understanding and consciousness about radiation safety are essential in order to minimize the risk to the theater staff and the fluoroscopic operator. The findings of this study indicate that the staff members in orthopedic surgery have an inadequate comprehension of radiation safety. While orthopedic surgeons often use fluoroscopic imaging in their everyday operations, they lack sufficient knowledge about the safety concerns associated with radiation exposure from this imaging method. Simultaneously, the existing personal protective equipment is either underutilized or not used at all. Hence, it is recommended that the orthopedic department at the University of Pretoria implement a training program focused on radiation safety and protection.

24. Ivy June Boniface1, Nur Maizatul Azra binti Mukhtar-2020 The importance of personel protective equipments, Radiation safety and precaution become a responsibility for everyone.

The objective is to provide a radiation-secure setting that guarantees the absence of radiation

exposure and any potential damage to individuals. It is important for those employed in environments with high radiation levels to use personal protection equipment (PPE) to its maximum capacity in order to minimize the risk of accidental exposure to primary or scattered radiation. It is recommended that all institutions that provide radiation therapy, including those that provide diagnostic radiological services, implement staff awareness training and create systems for quality assurance and control. The resource evaluation proved to be quite advantageous in instructing residents on the proper radiation methods during their research activities at a university hospital. Overall, most of the outcomes were beneficial for this project since a substantial amount of data and information were collected. Future researchers are recommended to expand the scope of the study by collecting data from other databases, including those available in books and other resources, in addition to the Internet. A significant percentage of participants demonstrate confidence in the Personal Protective Equipment's capacity to protect them. To emphasize the need of personal protective equipment in protecting against occupational radiation, it is recommended to increase the frequency of safety campaigns and safety seminars, and to enhance worker knowledge.

25. Ruben Pauwels, 3Keith Horner, 4Jenia Vassileva and 5Madan M. Rehani-2019 Thyroid shielding in cone beam computed tomography: recommendations towards appropriate use.
The objective of this study is to provide instructions on the appropriate utilization of thyroid shielding in dental cone beam CT (CBCT). Based on the existing data on thyroid radiosensitivity, dosimetric data with and without shielding, and an illustration of the potential adverse effects of thyroid shielding, a concise set of recommendations was formulated. Current risk models indicate that thyroid sensitivity is particularly elevated throughout early childhood and much higher in females. Studies employing adult male, female, and pediatric reference phantoms have shown that wearing a thyroid collar that fits tightly and has a lead-equivalent thickness of at least 0.25 mm may dramatically lower the equivalent dose to the thyroid by an average of 45.9%. Thus, it is recommended that adults up to the age of 50 and minors undergoing CBCT screening should consistently use thyroid shielding. To reduce the increase in X-ray tube current caused by thyroid shielding resulting from automated exposure control systems, it is advisable to install the shielding collar after taking the scout photographs. The perspectives on the appropriate use of shielding may change in response to current advancements

in CT technology, particularly if real-time tube current modulation is implemented in dental CBCT imaging in the future. Avoid using shielding while conducting radiological examination of tissues below the lower limit of the mandible, since it might cause the appearance of metal artifacts.

26. MH Rahman-2019 Radiation Hazard, Safety, Control and Protection.

In the present era of nuclear medicine and diagnostic and therapeutic radiography, ensuring radiation safety is a crucial concern. Every operational architecture of a radiology or nuclear medicine department must include radiation protection. The main objectives of radiation protection are to provide shielding for workers who are directly or indirectly exposed to radiation in order to prevent excessive radiation exposure, while also maintaining the benefits of such exposure. Radiation protection encompasses the act of protecting patients and staff from unintended exposure to radiation, monitoring the radiation exposure of workers and the work environment, and providing a valid reason for procedures requiring radiation exposure. Additionally, it employs a minimal level of radiation exposure that is consistent with the process while yet providing sufficient diagnostic information. The responsibilities of the RSO and other administrative authorities of the department/hospital include regularly monitoring the radiation levels in the relevant department, overseeing the adherence to radiation safety regulations, and performing frequent educational activities.

27. Rebecca M. Marsh1 Michael Silosky Marsh RM, Silosky M-2019 Patient Shielding in Diagnostic Imaging: Discontinuing a Legacy Practice.

Granting specialists the discretion to provide shielding when required is of utmost importance. Patients suffering from intense anxiety caused by the lack of protection should be educated about the potential outcomes. If the technician still believes that shielding would have a substantial positive impact on the patient's psychological well-being, they should be authorized to make this professional judgment. However, it is imperative to emphasize to medical workers that the practice of shielding must be completely avoided. Despite the increasing amount of data suggesting that patient shielding should be stopped, the practice persists. Radiologic technologists, medical physicists, and radiologists have a responsibility to become rational and influential figures in this issue, despite the challenging nature of change. Prior to that moment,

medical establishments, educational initiatives, certifying organizations, and governing bodies will continue to endorse and engage in a well-established procedure that poses a significant danger but provides few benefits to patient well-being.

28. Hassan Zarghani1, Reza Jafari2-2019 Risk Assessment of Public Gamma Radiation in Some Provinces of Iran.

Table 1 demonstrates the impact of altitude, latitude, and longitude on the calculated average absorbed dose rates for both indoor and outdoor settings. The study's findings indicated the highest and lowest rates of outdoor dose, respectively. However, the minimum and maximum indoor dose rates, respectively. The exposure rates for indoor and outdoor situations were determined to have average values respectively. Background radiation measurements are crucial for evaluating health hazards, especially in most countries.

29. A. Ribeiro a, *, O. Husson b,N.Dreyc, I. Murray a,K.Maya, J. Thurston a,W.Oyen-2019 Ionising radiation exposure from medical imaging e A review of Patient's awareness.

Based on the research examined in this review, it is recommended that patients be provided with information on their exposure to ionizing radiation. There is a clear need for improved communication between healthcare professionals and patients regarding ionizing radiation exposure, since people generally have little understanding on the subject. To enable patients to make informed decisions, healthcare professionals and the imaging community should promote communication with patients and caregivers by providing them with precise and relevant information about the benefits and potential long-term risks associated with their exposure to ionizing radiation. Additional research is required to investigate the level of knowledge and comprehension among patients about ionizing radiation used in diagnostic scans and treatments, particularly in the area of nuclear medicine. This is necessary since only a small fraction of patients have been included in the limited number of studies conducted on this topic.

30. M.M. Abuzaid1*, W. Elshami1, M. Shawki2, D. Salama3-2019 Assessment of compliances to radiation safety and protection at the radiology department.

Radiographers must use proactive strategies to ensure the safety of customers, staff, and oneself. Preventing patients from unnecessary primary and secondary radiation exposure is of utmost

importance. Shielding must be done in circumstances when the radiation beam should not be principally directed at the gonads, thyroid, or eyes, unless it is necessary. Cones, filters, and collimation are essential tools for reducing scatter radiation and avoiding unnecessary tissue exposure to radiation. In order to minimize image duplication and maximize patient comfort, it is advisable to use sponges, sand bags, compression bands, and other immobilization techniques. It is important to choose exposure values with caution in order to avoid motion blur and image distortion, while ensuring high-quality diagnostic information. The criteria included in this context are brief durations of exposure, geometric considerations, the distance between the source and the picture, the size of the focus point, and the filtering of the tube. These measures facilitate the actualization of ALARA. In order to ensure compliance with radiation safety norms and regulations in radiology departments, it is necessary to implement a systematic and coordinated approach via the implementation of corrective measures. In addition, continuous education is crucial, especially for younger radiographers.

31. Amanda Partap1, Ryan Raghunanan1, Kimani White2 and Trevor Seepaul-2019 Knowledge and practice of radiation safety among health professionals in Trinidad.

Multiple studies have shown the lack of knowledge among medical staff about ionizing radiation and the proper use of associated equipment. After careful evaluation, we have determined that it is essential to provide formal training on the use of ionizing radiation equipment. This is necessary to ensure the safety of both people and patients, particularly due to the overall inadequate performance of our community. Healthcare professionals who make use of these tools should also be provided with more convenient access to personal protection equipment. In order to reduce the amount of radiation that the patient and people in the room are exposed to, operators must consistently follow the "As Low As Reasonably Achievable" requirements while using this equipment. Annual recertification courses are crucial for individuals to be updated on recent advancements and to be reminded of safety procedures that are sometimes neglected.

32.H. Kaheni1, A. Chaparian2, *, R. Nafisi-Moghadam3 and N. Hamzian1-2018 Assessment of image quality and radiation dose in some models of digital radiography system.

This examination assesses the diagnostic accuracy of four different digital radiography systems

by evaluating the quality of the pictures produced. The results of this research may be used to guide the selection and procurement of new systems, in line with the ALARA principle of radiation protection. This will help safeguard both patients and radiologists by minimizing unnecessary radiation exposure.

33. Hassan Zarghani1, Mohammad Taghi Bahreyni Toossi-2018 Local Diagnostic Reference Levels for Some Common Diagnostic X-Ray Examinations In Sabzevar County of Iran.

Minimizing the potential risk of radiation exposure during any surgical procedure is of utmost importance, since there is no acceptable threshold for ionizing radiation. The linear no threshold hypothesis asserts that reducing the doses of radiation that the public gets via medical procedures is an essential first measure for radiation protection, thus reducing the risk of radiation exposure. Upon comparing our results with those of previous study, it became evident that the machine configuration parameters were a significant factor contributing to the variability in dose. Regarding the significance of machine settings for picture quality and patient dosage, these parameters may be modified to minimize the patient dose while preserving the integrity of the image quality. Consequently, we recommended that the radiation therapists in the county being investigated follow the NRPB's criteria and use high-kVp methods to minimize the amount of radiation received by patients.

34. L. O'Hora1, *, M.L. Ryan2 and L. Rainford2 1CHOArea 1, Donegal-2018 Survey of key radiation safety practices in interventional radiology.

Adhering to stringent radiation safety rules is crucial in the rapidly advancing area of interventional radiology, since it has the potential to expose patients to substantial radiation doses. Prior to, during, and after treatments, it is important to consider IR radiation safety standards by ensuring proper patient consent, monitoring the dosage, and doing patient follow-up. A questionnaire-based technique was used to undertake surveys of fixed IR departments in England and Ireland in order to ascertain clinical practice in relation to radiation safety. This investigation examined the radiation safety practices associated with infrared radiation for a significant number of procedures conducted annually in England and Ireland. There is a scarcity of reporting and use of the patient skin dosage surrogate parameter in Kar. Less than 50% of

respondents effectively use to identify potential tissue reactions and provide proper patient communication and follow-up. The IR process seldom includes all the radiation implications in its communication. Despite the availability of best practice standards, there is a lack of adherence to them in the promotion of IR dose parameter specific training as an effective therapy. This research has suggested a possibly complex and varied explanation for this phenomenon.

35. Gabriel Bartal, MD, FCIRSE, FSIR, *, Anna M. Sailer, MD, PhD, and Eliseo Vano-2018 Whether the apron contains lead or other material is not the main issue.

Regardless, it is well known that lead pollutes the environment. In order to mitigate environmental contamination, it is essential to handle the disposal of these degrading aprons with utmost care. A study found that three lightweight non-lead aprons did not match the manufacturer's declared Pb equivalency levels when examined according to the broad beam requirements indicated earlier. Another apron made of lead composite material, which met the recommended labeling criteria, was used in the same study.

36. Bo Kyung Cheon, Cho Long Kim, Ka Ram Kim, Min Hye Kang, Jeong Ae Lim, Nam Sik Woo, Ka Young Rhee, Hae Kyoung Kim, and Jae Hun Kim-2018 Radiation safety: a focus on lead aprons and thyroid shields in interventional pain management.

Currently, in Korea, there is no mandatory need to do radiation safety training in order to get certification as a pain specialist. However, to enhance awareness and comprehension of radiation safety, education on the subject is necessary. It is vital to instruct aspiring pain professionals in the proper and secure methods of radiation use. The ALARA principles, which include time, distance, and shielding, are essential methods for reducing radiation exposure. Lead aprons and thyroid shields are the most prevalent types of personal radiation protection equipment, yet their importance is sometimes overlooked. Improper use or maintenance of protective equipment increases the danger of radiation exposure. Essential and indispensable techniques for using personal protective equipment include donning well-fitting and lightweight thyroid shields and lead aprons, as well as arranging annual examinations. To effectively reduce radiation exposure, it is imperative to mandate the acquisition of essential knowledge and training on the proper use of radiation protective gear and equipment.

37. H. Bijwaard a,b,*, G. de Vries a, J. Scheurleer a, T. Roding a, H. Erenstein c, W. Ravensbergen c, S. Haarmans-Jonkman c, F. van Welie d-2017 Compliance to Diagnostic Reference Levels for radiation exposure in common radiological procedures in Dutch hospitals:

A countrywide survey done by students specializing in medical imaging. Within Dutch hospitals, compliance with diagnostic reference values for radiation exposure in regular radiography procedures: A physicist.A countrywide poll was undertaken by students specializing in medical imaging. This study takes an additional step: diagnostic radiography students get training in performing these assessments and conducting examinations under the guidance of a local medical physicist. The main discovery of this research is that this is an effective approach that might be used in other protocols and international contexts. In our perspective, there are two main benefits to utilizing radiography students. Firstly, it provides a practical and cost-effective means of collecting dose data from multiple hospitals. Secondly, and of greater significance, it allows for the training of students in a task that they are likely to undertake post-graduation, while also acquainting them with the practical implementation of radiation protection. Note that this is the method used to evaluate the DRLs' adherence to student performances. This may be easily resolved by ensuring effective supervision from experienced radiographers and medical physicists. By completing a nationwide dose survey, the students acquired information regarding radiation safety in the area of medical imaging. The survey's results indicate that almost all the hospitals that took part in the study adhere to the Dose Reference Levels (DRLs), even though there is a potential for three times more variance in dose levels among different institutions. The aforementioned statement implies that the current Dutch DRL values are in need of an update, since they have not been obtained via a comprehensive statewide dose study. The study's 75th percentile findings may be applied to operations that were analyzed at a significant number of institutions for this purpose. However, it is important to note that not all processes for which a DRL was proposed were subject to this. Acquiring sufficient data posed occasional difficulties, especially for therapies involving children. For some processes, the length of measurement may be prolonged.

38. Seyedeh Shohreh Alavi, Sima Taghizadeh Dabbagh1, Mahya Abbasi, Ramin Mehrdad-2017 Medical radiation workers' knowledge, attitude, and practice to protect themselves

against ionizing radiation in Tehran Province, Iran.

Employees who come into contact with medical radiation may inadvertently be exposed to ionizing radiation. This study assessed the knowledge, attitudes, and behaviors of healthcare workers who are often exposed to radiation in their workplace, specifically in regards to radiation protection. The study's results indicated that radiation workers did not choose to employ RP KAP as a means of protecting themselves against radiation. Healthcare practitioners with radiology degrees had a greater understanding of RP. Consequently, it is strongly recommended that medical radiation specialists undergo preservice RP training. Participation in in-service training courses is crucial for developing and maintaining a good RP mindset. Cultivating a self-care culture is essential for ensuring enhanced performance.

39. M. Alhasan1*, M. Abdelrahman1, H. Alewaidat1, Y. Khader2-2016 Radiation dose awareness of radiologic technologists.

In order to protect themselves and others from the harmful effects of radiation, it is necessary for radiology staff members to establish a valid reason for their exposure to radiation. This study examined individuals' understanding of radiation safety and dose. Collaboration between the radiology team and referring clinicians is necessary to mitigate the risks associated with radiation in medical imaging. Prior to conducting a radiologic examination, it is essential for medical personnel to provide a comprehensive explanation of X-ray exposures and possess a thorough understanding of methods to mitigate the risks associated with radiation exposure, both for themselves and others. The results suggest that radiographers possess a limited comprehension of radiation exposure and protection. The absence of continuous education in radiation safety among Jordanian radiographers may have led to the limited degree of awareness. Further investigation is necessary to ascertain the underlying factors contributing to the limited knowledge among radiologists and to examine its consequences. The radiographers at the selected Jordanian hospitals demonstrated inadequate understanding of radiation dose and safety protocols. It is highly recommended to establish a yearly radiographer awareness examination via the Jordanian national radiation agency.

40. Thokchom Dewan Singh1,2, T Jayaraman2 and B Arunkumar Sharma-2017 This study aims to assess the adequacy level of radiological protection systems available in the

diagnostic radiology facilities located in three capital cities of North East (NE) India.

Through a multidisciplinary approach, this study aims to understand the comprehension, application, and perception of safety codes and standards in diagnostic radiology. These codes and standards, developed by the International Atomic Energy Agency (IAEA) and the Atomic Energy Regulatory Board (AERB), are designed to ensure sufficient radiological protection in facilities. A total of around thirty diagnostic radiological clinics were selected randomly from the capital cities of Imphal, Manipur; Shillong, Meghalaya; and Guwahati, Assam. In this study, a semi-structured questionnaire was used, which was developed utilizing an interdisciplinary approach. Facilities often deviate from national and international safety criteria due to complex and arduous factors that are intertwined with the many stakeholders involved. The study identified several factors that contribute to these deviations, such as employees' low perception of risk, their tendency to use a specific heuristic approach in decision-making, their preference for maintaining previous risky work practices, the absence of an institutional risk management system, the influence of hierarchy, and a lack of trust in the regulatory system, among other factors. Some staff members also lacked the necessary technical skills to effectively carry out quality assurance tasks and had inadequate knowledge about radiation safety. In order to resolve the issues mentioned earlier, the facilities should adopt various programs such as continuous education initiatives, radiation safety meetings, improving workplace practices, management training, and other relevant initiatives like workshops, conferences, and awareness campaigns. Improving communication among many stakeholders, including workers, patients, lawmakers, equipment suppliers, and regulators, is an additional method to enhance the level of acceptable radiation protection in facilities (AERB). Given the possible consequences of inadequate facility monitoring, the AERB must examine various communication options. In addition, the AERB must take prompt and resolute action regarding the licensing and registration of all facilities.

41. Agapi Ploussi, Efstathios P Efstathopoulos-2016 The increased use of ionization radiation for diagnostic and therapeutic purposes.

The safety and well-being of patients are significantly compromised by the elevated levels of radiation exposure during interventional procedures and the rapid progress in computed tomography.

RPC represents the integration of many objectives, perspectives, regulations, and procedures

connected to radiation safety. The basis of an RPC program is a dynamic process that necessitates continuous evaluation and systematic enhancement via the use of quantitative and qualitative methods to ascertain the program's effectiveness in achieving its goals and the efficiency of its implementation. Radiation Protection and Control (RPC) necessitates a comprehensive understanding of the hazards associated with radiation, strict compliance with safety laws, and active involvement from all parties involved. It should be an essential element of therapeutic practice. The primary hindrances to the deployment of RPC are a lack of knowledge and a deficiency in collaboration. In order to establish a robust RPC program, it is essential for authorities, experts, staff members, and patients to have a thorough comprehension of the role and importance of RPC in a radiology department. This will help bridge the gap between theoretical understanding and practical implementation.

42. Kyung-Hyun Do-2016 Regulation is essential to control medical radiation exposure. For medical radiation exposure control, Korea has two separate control system.

The Ministry of Health and Welfare administers the Medical Services Act, which regulates diagnostic radiation. Conversely, the Nuclear Safety and Security Commission is tasked with supervising the Nuclear Safety Act, which includes the oversight of nuclear medicine and therapeutic radiation. The Medical Service Act has two sections: the first section governs the safety supervision of radiation-protective facilities and equipment used in diagnostic X-rays, which is supervised by the Korean Center for Disease Control. The second section focuses on the installation and operation of specialized quality assurance systems for medical equipment, namely CT, MRI, and mammography devices. The current legislation primarily focuses on the regulation of radiation protective facilities, occupational exposure, and equipment, rather than prioritizing patient safety. Multiple national and international organizations have made significant efforts to regulate and monitor medical radiation exposure via the implementation of standards, certification processes, and even legislation. Sustained engagement from organizations and health professionals might facilitate the achievement of this goal.

43. Jimma lone phd, Fipemand 2friedoz¨ olzer,- 2016 Schools of ethics and demonstrably part of a worldwide “common morality”, can be applied in radiation protection.

It may be advantageous and practical to take these concepts into account when facing ethical

dilemmas in radiology, instead than just relying on the recognized principles of justification, optimization, and dosage limitation. The essay outlines six scenarios involving medical examinations conducted on individuals who have been exposed to a medical environment. The objective is to showcase the practical application of the proposed principles in a diverse set of realistic scenarios, provide an overview of the initial execution of the approach, and promote further investigation to identify the most efficient technique for ensuring radiation safety in diagnostic imaging in the future. This requires providing examples of situations that may provide challenges when assessed according to the practical value system. However, we do not want to overly critique or provide specific remedies for these situations within this particular framework. Effective solutions will inevitably need scrutiny and evaluation in the operational domain of departments that provide everyday services. The proposed solutions presented here may seem rudimentary and shallow. Considering its basis in medical ethics and society norms, it is plausible to anticipate that the pragmatic value system will get more recognition in the area of medicine in comparison to the ICRP principles. They might help improve the dissemination of essential radiation safety guidelines more effectively to its main area of application. They should help to forward the development of a set of guidelines for radiation protection.

44. Seung-Jae Hyun*, Ki-Jeong Kim, Tae-Ahn Jahng,-2016 Despite the firmly established occupational risk of exposure to X-rays, they are used extensively in spine surgeries.

The use of lead aprons as a protective barrier is often regarded as the most commonly employed safety precaution. We conducted a measurement of their efficacy in attenuating radiation inside a real-world setting. In this prospective study, 0.5 mm lead aprons were used to assess the level of protection they provide surgeons from intraoperative X-ray radiation emitted by C-arms. It was shown that these aprons only blocked 37.1% of the radiation directed towards the surgeon. By using robotic guidance in a minimally invasive surgery rather than an open fluoroscopically guided technique, the dosage of fluoroscopy is decreased by 62.5%, which is about double the reduction achieved when lead aprons are used in a freehand surgical operation. Hence, we may infer that decreasing the dose is a more favorable approach than only relying on lead aprons for safeguarding. We recommend adopting protocols and technical innovations that reduce the frequency of X-ray exposure for the surgical crew.

45. Reinier C Hoogeveen, Bart Hazenoot, Gerard C H Sanderink and W Erwin R

Berkhout-2016 To evaluate the utility of the application of a thyroid shield in intraoral radiography.

while aligning using a rectangular shape. The use of a thyroid shield greatly reduces the amount of radiation that reaches the thyroid gland when exposed to radiation in the upper front region of the body. Thyroid shielding has a little impact on reducing the residual exposures compared to rectangular collimation. It is advisable to use a thyroid shield while doing upper anterior radiography.

46. M. M. Abuzaid1,*, W. Elshami1 and Christopher Steelman2-2016 Measurements of radiation exposure of radiography students during their clinical training using tld.

Radiation dose monitoring is necessary during clinical training to demonstrate to radiography students the extent of radiation protection issues and to instill in them a commitment to following safe methods throughout their professional lives. Health institutions are required to monitor the radiation dose of medical professionals due to the significant human exposure caused by the use of ionizing radiation in medicine, which is second only to environmental radiation. An essential element of ensuring personal radiation safety is the regular monitoring of radiation exposure in the workplace. Radiation workers who operate X-ray equipment, fluoroscopy units, computed tomography systems, and work with both sealed and unsealed radioisotopes are required to wear dosimeters. Thermoluminescence dosimetry (TLD) is generally recognized as the most versatile technique for accurately measuring gamma, beta, and X radiations, especially for those involved in monitoring these types of radiation. The TLD, or Thermoluminescent Dosimeter, is a widely used passive technology for assessing individual dose. An study of the occupational exposure data for that time period demonstrates that all results were below the prescribed dose limits. This might be attributed to the implementation of radiation safety regulations, technological breakthroughs, improvements in work processes, and enhanced training. The clinical and didactic teaching in radiological protection enhances students' proficiency in safely handling and operating radiation sources. Finally, it is imperative for students engaged in medical imaging and utilizing ionizing radiation to adhere to both national and international protocols, maintain a diligent commitment to ongoing education throughout their professional journey, and employ radiation protection techniques such as ALARA (as low as reasonably achievable) in their daily tasks.

47. Matthew E. Zygmont, MD, Jason N. Itri, MD, PhD, Andrew B. Rosenkrantz-2016 Radiology Research in Quality and Safety.

Establishing a culture of safety inside healthcare facilities leads to a reduction in adverse safety events. While the concept of peer review is beneficial, the implementation of methods like RADPEER in most practices fails to successfully promote changes in practice. By developing techniques to compare imaging examinations with "benchmark standards," such as comparing knee arthroscopy with knee MRI or coronary CT angiography with classic coronary angiography, it is possible to more accurately assess the diagnostic accuracy in radiology. This article examines the essential prerequisites for promoting effective research on quality and safety. Key elements of this foundation are instructional training, streamlined IT infrastructure, and organizational support for an equitable culture. This document presents a concise overview of the most effective methods for generating incident reports. We examine prevalent indicators of quality performance and discuss the potential outlook for the future, along with the current patterns. In the next years, radiology will prioritize the development of new metrics and improvement of existing ones to optimize patient outcomes and treatment.

48. Vahid Karami 1, *Mansour Zabihzadeh12, 3, Abdolreza Gilavand 4, Nasim Shams5-2016 Survey of the Use of X-ray Beam Collimator and Shielding Tools during Infant Chest Radiography.

It has been advised for a long time that patients who are having radiological procedures should reduce their radiation exposure by using shielding equipment and X-ray beam collimators. This inquiry focused on the implementation of safety procedures during newborn chest radiography. Due to inadequate shielding and excessive collimation, newborns in the hospitals being investigated are being exposed to unnecessary levels of radiation. It is very recommended to adhere to safety requirements, especially while doing radiography on newborns. The thyroid gland, being in close proximity to the radiation field, is inadvertently exposed to ionizing radiation during chest X-rays performed on infants, making it one of the organs that is most vulnerable to radiation. Radiographers should diligently use straightforward and pragmatic safety measures. Forming a radiation protection team consisting of radiologists, radiographers, and health physics specialists might be beneficial in implementing safety measures such as X-ray beam collimation and shielding.

49. AERB RADIATION-PROTECTION-IN-DIAGNOSTIC-RADIOLOGY.pdf
https://aerb.gov.in/images/PDF/DiagnosticRadiology/RADIATION-PROTECTION-IN-DIAGNOSTIC-RADIOLOGY.pdf

The Most of the radiation dose received by the operator (provided the primary beam is avoided) is due to scattered radiation from the patient. Know your equipment Use protective shields (lead apron, mounted shields/flaps, ceiling suspended screens as applicable) . Avoid holding of patient without adequate protection. Keep hands out of the primary beam Stand in the correct place: opposite the X ray tube rather than near the X ray tube.(knowledge of iso-dose curve) Always wear your personal radiation monitoring badge and use them in the right manner Make sure that x ray equipment is properly functioning and periodically tested and maintained All actions to reduce patient dose will also reduce staff dose Follow Time, Distance, Shielding golden rules.

50. ICRP, 2021. Use of dose quantities in radiological protection. ICRP Publication 147. Ann. ICRP 50(1).
Authors on behalf of ICRP
J.D. Harrison, M. Balonov, F. Bochud, C. Martin, H-G. Menzel, P. Ortiz-Lopez, R. Smith-Bindman, J.R. Simmonds, R. Wakeford

This publication provides a review of the use of dose quantities in the system of radiological protection and the scientific basis for the approaches taken. An important aim has been to provide clarity on a number of issues that have caused confusion and some controversy. (117) A central issue has been the relationship between effective dose and stochastic risks, principally the risk of cancer. It is concluded that effective dose can be used as an 'approximate indicator of possible risk'. This wording was chosen to emphasize the uncertainties inherent in the estimation of risk, and to acknowledge that the doses under consideration are, in many cases, below the levels at which direct epidemiological observations of excess cases of cancer are available. With these caveats, the most straightforward interpretation of the available scientific evidence for the purposes of radiological protection is that a nominal lifetime fatal cancer risk of approximately. The tissue weighting factors used in the calculation of effective dose are based on relative detriment values that are averaged over males and females and all ages. Data provided in this publication illustrate the substantial differences observed in the incidence of cancer and in the corresponding estimates of detriment according to age at irradiation, with notable differences between males and females in the age dependence of cancer risk for individual cancer sites. These differences are concealed in the use of age-, sex-, and population-averaged detriment values and a single set of tissue weighting factors. The reasoning has been that the current approach provides a pragmatic, equitable, and workable system in which dose criteria are set and optimization applied to all workers and all members of the public

4 MATERIALS AND METHOD

DATA COLLECTION

Data collection from RSO and technicians of radiodiagnosis department of hospitals and centers

SAMPLE SIZE

In this study, a sample size of 306 informed google forms is selected for comprehensive analysis. The choice to use a sample size of 306 was made in light of the resources that were available. The chosen sample size is thought to be enough to accomplish the study's goals within the allotted time limit, even if a higher sample size could provide better statistical power.

METHOD

A questionnaire survey study is conducted through google form at the Radiodiagnosis Department of multiple hospitals and centres in western UP region, data collected from RSO and Technicians. The questions include the Radiation Safety and Standard Operational Compliances Guidelines by AERB in Radiodiagnosis Department. The Ethical approval was obtained from the institution. The questionnaire is developed based on previous studies and AERB Elora compliances software. A systematic questionnaire created especially to record pertinent details of radiation safety contacts between radiodiagnosis department personnel and RSO was used in the study.

INCLUSION CRITERIA

RSO/ Technicians – Radiation Safety Officer who had recently looked out the radiology department and technicians were selected to participate in the survey.

EXCLUSION CRITERIA

1- RSO/ Technician who are not cooperating.

2- Hospital does not registered with AERB.

DURATION OF STUDY

January to June 2024

ETHICAL APPROVAL

The Ethical approval was obtained from the institution.

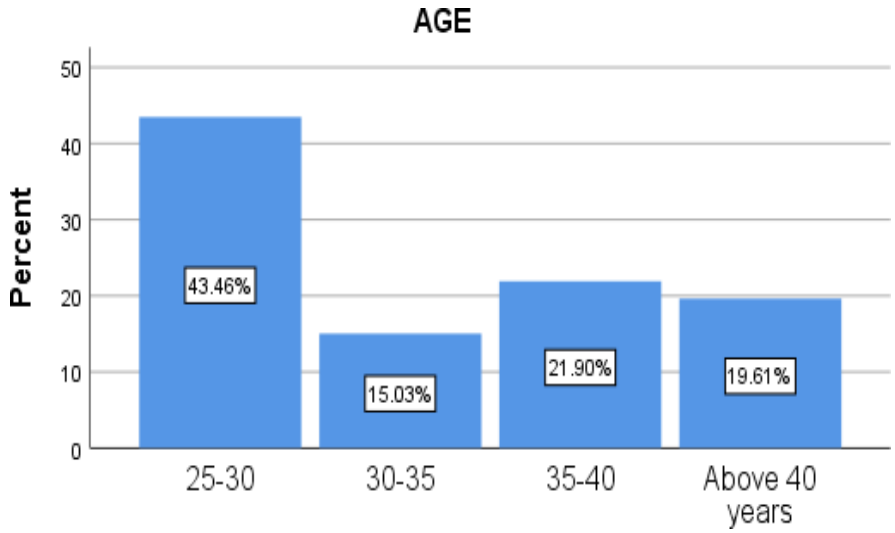
5 Result Summary

In the section under "Results," the findings of the study are presented, with a particular emphasis on outcomes that are in line with the conclusions of the research, using the SPSS software for data analysis. In order to determine significant differences and connections among variables, statistical studies made use of independent t-tests. This was especially true when comparing the means of different groups.The efficiency of these tests in determining differences on continuous variables, such as scoreson psychological constructs or outcome measures, was a primary factor in their selection. Demographic information, including age, gender, and educational background, was carefully included into the study to provide context and enhance understanding of the composition of the research sample. The purpose of this demographic information is to bring to light possible impacts on the findings that were observed, providing insights into the ways in which participant characteristics may affect the outcomes of the research.

Table 1 Demographic Variable

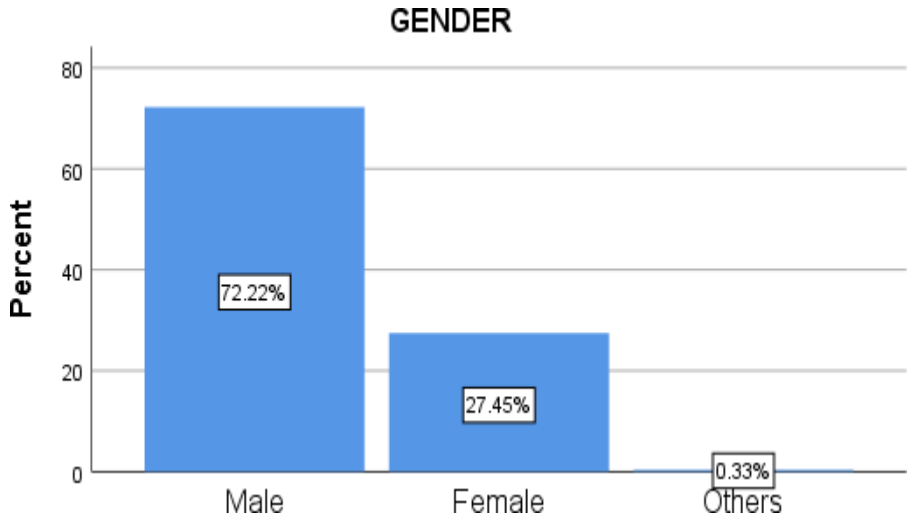
		Frequency	**Percent**
AGE	25-30	133	43.5
	30-35	46	15.0
	35-40	67	21.9
	Above 40 years	60	19.6
	Total	306	100.0
GENDER	Male	221	72.2
	Female	84	27.5
	Others	1	0.3
	Total	306	100.0
Education	Diploma	141	46.1
	Bachelors	98	32.0
	Masters	44	14.4
	Others	23	7.5

	Total	306	100.0
Experience	1-3 years	65	21.2
	3-5 years	66	21.6
	5-7 Years	63	20.6
	Above 7 years	112	36.6
	Total	306	100.0
Employment	Private hospital	142	46.4
	Imaging Centre	89	29.1
	Clinic (Small/large)	49	16.0
	Government Hospital	11	3.6
	Others	15	4.9
	Total	306	100.0
Area	Gauthambudh Nagar	126	41.2
	Ghaziabad	59	19.3
	Bulandshahar	17	5.6
	Aligarh	20	6.5
	Hapur	16	5.2
	Meerut	24	7.8
	sharampur	19	6.2
	Muradabad	25	8.2
	Total	306	100



Graph-1 Age

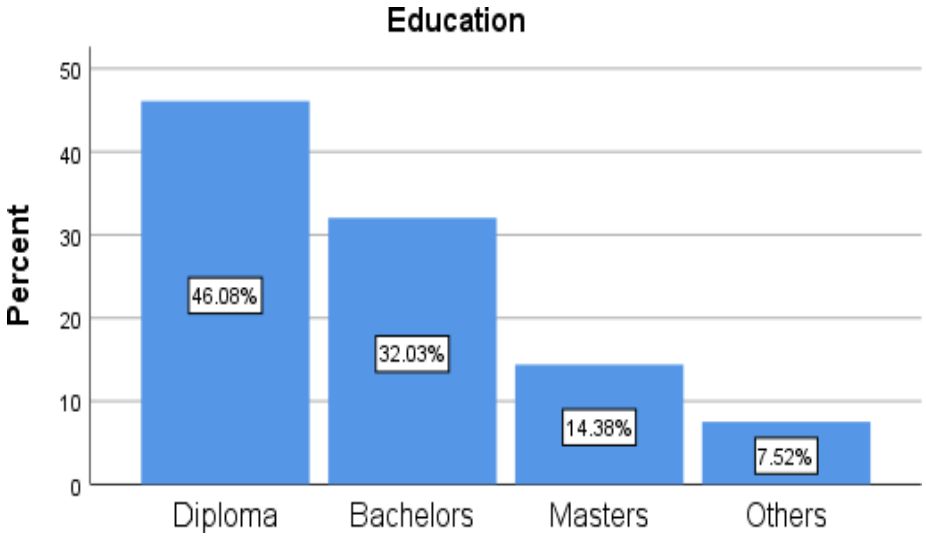
Age: The age distribution of the respondents shows a wide range, with the bulk of respondents (n=133) falling into the 25–30-year age. The second biggest group, with 21.9% (n=67), is the 35–40-year-old age range. Respondents over 40 make up 19.6% of the sample (n = 60), with respondents between the ages of 30 and 35 making up the smallest group (n = 46). There are 306 individuals in all in this research



Graph-2 Gender

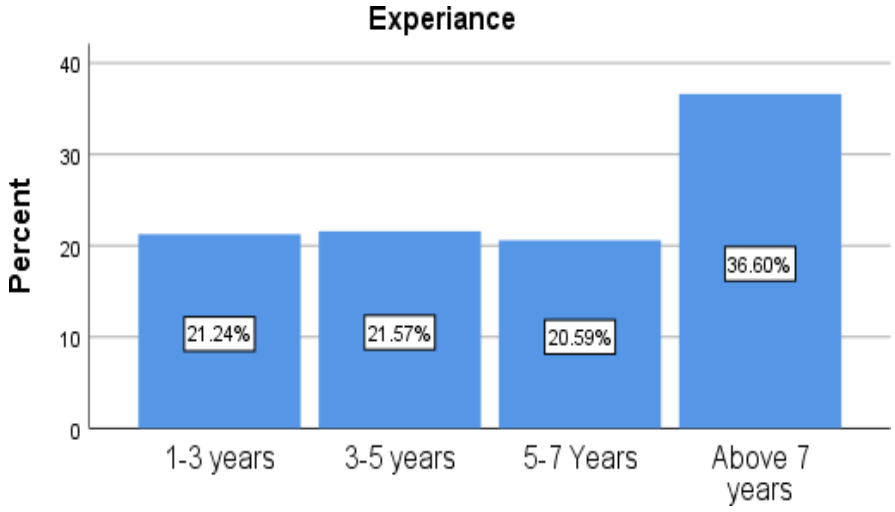
Gender: Of the sample's 72.2% (n=221) male respondents, the gender distribution indicates a

sizable majority of male respondents. Of the 84 respondents, 27.5% are female. Of these, one respondent, or 0.3%, identified as "Others." There have been 306 responders in all.



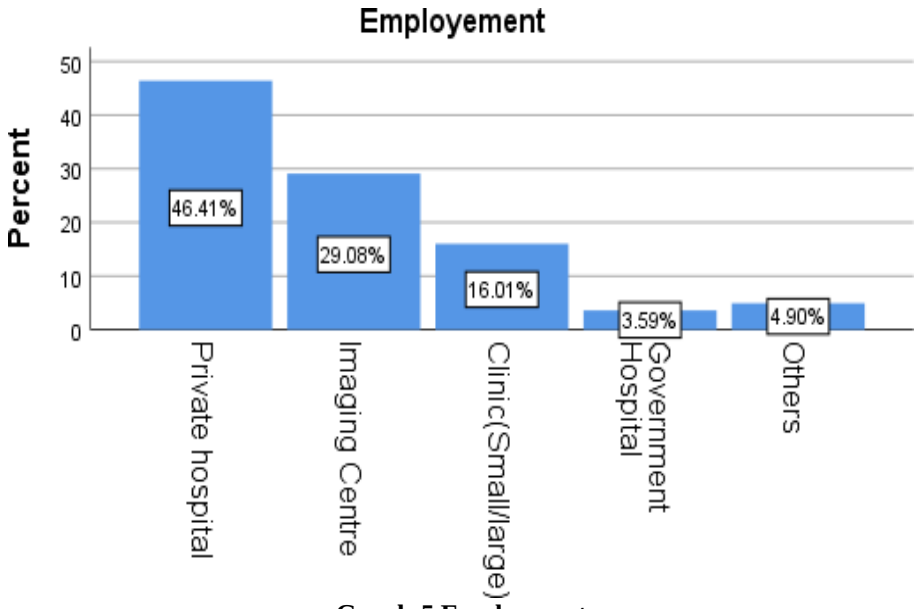
Graph-3 Education

Education: Of the respondents, 46.1% (n=141) of the sample have a diploma, making up the greatest portion of their educational background. Of the respondents, 32.0% (n = 98) have a bachelor's degree, and 14.4% (n = 44) have a master's degree. A lesser percentage, 7.5% (n=23), is categorized as "Others." There have been 306 responders in all.



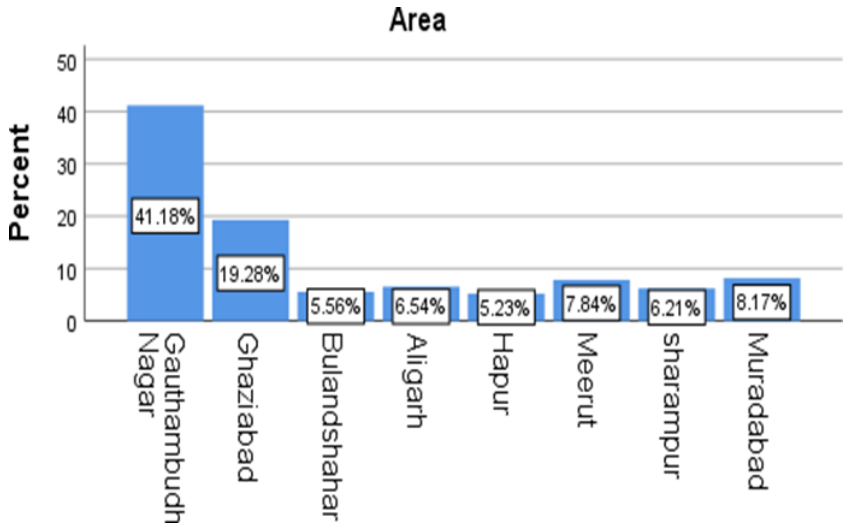
Graph-4 Experience

Experience: The sample consisted of 112 respondents, or 36.6% of the total, who had more than 7 years of experience. The respondents' degrees of experience varied. The group with 3-5 years of experience makes up 21.6% (n=66), while the group with 1-3 years of experience is not far behind at 21.2% (n=65). Of the total respondents (n = 63), 20.6% had five to seven years of experience. There have been 306 responders in all.



Graph-5 Employment

Employment: Of the respondents, 46.4% (n=142) are employed in private hospitals, which accounts for over half of their work environments. Of the respondents, 29.1% (n = 89) work at imaging facilities, and 16.0% (n = 49) are employed in clinics, both small and big. Those working at government hospitals make up 3.6% (n=11), while 4.9% (n=15) fall into the "Others" group. There have been 306 responders in all.



Graph-6 Area

Area: The respondents are dispersed across different regions of the country; the biggest group, accounting for 41.2% (n=126) of the sample, lives in Gauthambudh Nagar. Other noteworthy places include Muradabad (8.2%, n=25), Meerut (7.8%, n=24), and Ghaziabad (19.3%, n=59). Bulandshahar (5.6%, n = 17), Aligarh (6.5%, n = 20), Hapur (5.2%, n = 16), and Sharampur (6.2%, n = 19) include smaller groupings. There have been 306 responders in all.

5.1 Proposed Hypothesis

H1. Knowledge of RSO/Technicians about Elora compliances.

Table 2 Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
ELORA	Equal variances assumed	3.745	.054	-4.871	304	.000	-.23253	.04774
	Equal variances not			-5.067	146.485	.000	-.23253	.04589

	assumed							

The table provided is the t-test table. In the "Levene's Test for Equality of Variances," it is assumed that the variances of different groups should be equal when comparing the means of two different groups. This assumption is the null hypothesis of the test, while the alternative hypothesis is that the variances are not equal across groups. The test results indicate that the p-value is more than 0.05. Therefore, the null hypothesis is not rejected. Therefore, if we assume equal variances, we can accept the alternative hypothesis of this test by examining the results of the first row. If the significance value in "Levene's Test for Equality of Variances" is less than 0.05, we reject the null hypothesis and proceed with the analysis using the second row. In this instance, the significance value for ELORA Compliances is larger than 0.05. Therefore, the first row is selected for further investigation. Based on the t-test table provided, the t-value is -4.871 and the significance value is 0.000, which is lower than the 0.05 threshold (5% significance level). The calculated t-value is less than -2 and the significance value is less than 0.05. Therefore, we cannot reject the null hypothesis and must accept the null hypothesis that states "There is a significant difference in Knowledge of RSO/Technicians about Elora compliances."

H2. Knowledge of RSO/Technicians about the safety devices compliances

Table 3 Independent Samples Test

		Levene's Test for Equality of Variances		**t-test for Equality of Means**				
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**	**Std. Error Difference**
Safety Device Compliances	Equal variances assumed	3.260	.072	-4.741	304	.000	-.18673	.03939
	Equal variances not assumed			-5.132	158.864	.000	-.18673	.03639

For Safety Device Compliances, the significance value in this situation is more than 0.05. Therefore, the first row is selected for further analysis. The t-value obtained from the t-test table is -4.741, and the significance value is 0.000, which is less than the predetermined significance threshold of 0.05 (5%). The calculated t-value is less than -2 and the significance value is less than 0.05. Therefore, we cannot reject the null hypothesis and must accept the null hypothesis that states "There is a significant difference in the knowledge of RSO/Technicians about safety devices compliances."

H3. Knowledge of RSO/Technicians in general radiation safety compliances, especiallyin rural areas.

Table 4 Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
General Radiation Safety Compliances	Equal variances assumed	.950	.330	-4.331	304	.000	-.15141	.03496
	Equal variances not assumed			-4.556	149.824	.000	-.15141	.03323

In this instance, the significance value for Safety Device Compliances is more than 0.05. Therefore, the first row is selected for further analysis. Based on the t-test table provided, the t-value is -4.556 and the significance value is 0.000, which is lower than the 0.05 threshold (5% significance level). The t-value obtained is less than -2 and the significance value is less than 0.05. Therefore, we cannot reject the null hypothesis and must accept the null hypothesis that states "There is a significant difference in the knowledge of RSO/Technicians in general radiation safety compliances, particularly in rural areas."

6 Discussion

The study's respondents' demographics reveal the sample makeup, allowing a deeper knowledge of how participant characteristics may have affected research conclusions. The bulk of responders, 43.5%, are 25-30 years old. This shows the younger population may strongly affect the results. The gender distribution is skewered, with 72.2% male and 27.5% female and just one "Others," showing little gender variety. A large number (46.1%) of respondents have a diploma, followed by bachelor's (32.0%) and master's (14.4%) degrees. The 7.5% 'Others' category shows the sample's educational variety, which might affect results, especially in understanding how educational attainment affects attitudes, knowledge, and behaviours relevant to the study's subject. Many respondents (36.6%) have more than seven years of experience. The 21.6% and 21.2% groups with 3-5 and 1-3 years of experience are close. The sample includes 20.6% with 5-7 years of experience. This variety of experience demonstrates that professional experience duration and depth may considerably affect insights and reactions. Many responders (46.4%) work in private hospitals, followed by imaging centres (29.1%) and clinics (16.0%), with lesser numbers in government hospitals (3.6%) and 'Others' (4.9%). Understanding organizational and operational settings that may affect respondents' experiences and perceptions requires this job distribution. Gautam buddha Nagar (41.2%) led the response, followed by Ghaziabad (19.3%), Muradabad (8.2%), Meerut (7.8%), and smaller groups in Bulandshahr, Aligarh, Hapur, and Sharanpur. This geographic distribution contextualizes geographical variances that may impact the results, showing how location-specific variables may shape respondents' perceptions and experiences. Overall, demographic data in the study provide context for evaluating research results. Age, gender, education, experience, occupation, and regional distribution show respondents' different backgrounds. Understanding these demographic parameters is essential for completely assessing the data and deriving valid inferences regarding participant characteristics' effects on research outcomes. Demographic insights deepen the study and provide topics for additional research to correct biases or trends.

With regard to the understanding of RSOs and Technicians with regard to Elora compliances (H1), safety device compliances (H2), and general radiation safety compliances, particularly in rural areas (H3), a number of trends and insights have emerged throughout the course of

conducting the examination. The majority of respondents, the majority of whom were male and many of whom had credentials, displayed varying degrees of knowledge across all of these categories. The majority of responses were male. There are significant information gaps that have been discovered in relation to Elora compliances, notably in areas that pertain to the operational state and the decommissioning of equipment. As a consequence of this, there is a need for educational interventions that are aimed primarily at enhancing the level of compliance knowledge. The fact that respondents complied with safety devices suggested that they had a moderate degree of expertise, with significant deficiencies being detected in the proper storage and maintenance of protective equipment. As a consequence of the findings, there is a chance that the safety of radiation might be jeopardized due to the inadequate use of protection regulations. The fact that knowledge gaps were more severe in rural areas was brought to light by general radiation safety compliances. This brought to light the need of increasing training and resources in these regions of the nation. In conclusion, the study emphasizes the need of continual training and the consistent application of safety standards in order to ensure that RSOs and technicians are in complete compliance with radiation safety regulations. Enhancing awareness in rural areas, which are more likely to have flaws that are more readily apparent, should get special attention. According to the findings of the t-test conducted on Elora compliances, the t-value was found to be -4.871, and the significance value was found to be 0.000. Due to the fact that this value is lower than the significance level of 0.05, we are able to accept the null hypothesis, which states that there is a significant difference in the knowledge of RSOs and Technicians about Elora compliances. In addition, the t-value for safety device compliances was -4.741, and the significance value was 0.000, which is once again less than 0.05. This indicates that the significance value is significantly under 0.05. This led to the acceptance of the null hypothesis, which stated that there is a significant difference in their levels of knowledge about the compliance of safety devices. After all was said and done, the t-value for general radiation safety compliances was -4.556, and the significance value was determined to be 0.000. The fact that this is the case suggests that there is a significant gap in the level of expertise held by RSOs and technicians when it comes to rural areas as well. The rural regions are most affected by this phenomenon. And compare after study of other related articles found that the compliance with the principles of

radiation protection in hospitals and centres was not satisfactory. It is strongly recommended in that articles the Radiation protection authority bodies monitor and visit radiation centers at regular and close intervals and consider more binding rules and guide lines for the radiation protection program and more training and education required in small cities and rural areas also same are required in western up areas. When I was interacting with RSO, technicians, radiologists and employer of the hospitals and centers, during the study most of the employer are not aware about AERB radiation safety compliances and ELORA, they also don't want qualified person specially in rural areas due to high salary issues. And they following the radiation protection compliances due to the NABH only. Most of the nominated RSO don't know about the RSO level and AERB safety compliances and this is the measure draw back for AERB. To resolve this issue AERB should start the RSQADR- Radaition Safety And Quality Assurance In Diagnostic Radiology course again or generate the system for rso approval through training or test. It also suggests that allied healthcare professional body watch out syllabus of radiography courses and monitor the educational institutions for quality of education and which course they are running. AERB also make sure that give the RSO approvals in diagnostic radiology for qualified persons to increase the AERB radiation safety compliances in all over India. using a TLD Badge is an integral part of radiology practice. But due to lack of awareness, most of the professionals avoid to wear the badge. As discussed above, it is important to distinguish effort to predict health effects of low level radiation for individuals

7 Conclusion

According to the findings of the investigation into the knowledge of RSOs and technicians about a variety of compliance areas, we found that The results that were similar across all tests shows major gap in the knowledge of RSO/Technicians about Elora, safety equipment, and general radiation safety compliances. As a result, focused educational interventions are required.

8- REFRENCES

1- Nima Hamzian 1, Saeed Asadian 2, Hassan Zarghani 3 Affiliations expand -2022
A Study of Radiation Protection Standards Compliance in Hospital Radiographic Departments in Iran
DOI: 10.31661/jbpe.v0i0.2108-1375

2. Prashant Kumar Jha1 , Himal Rai2 , Goutam Suklabaidya3 , Subhamoy Satpathy4-2022
Investigation of Awareness Level about TLD Badge among Radiology Students.
DOI: https://doi.org/10.52403/ijshr.20220455

3. Maajid Mohi Ud Din Malik1., Mohd. Arfat2* and Alok Kumar3, 2022
A questionnaire survey of radiation hazards and protection among medical and imaging technology students
DOI: http://dx.doi.org/10.24327/ijrsr.2022.1303.0111

4. Nyaichyai KS- 2022
Occupational radiation safety studies in Nepal
DOI: https://doi.org/10.3126/ijosh.v12i1.41037

5. Zinat Mohebbi1 , Roya Ershadpoor2 , Mohsen Ostovari3 , Mahnaz Rakhshan1-2021
Radiation Protection Capability of Operating Room Personnel: Development and Psychometric Properties of a Questionnaire.
doi: 10.31661/jbpe.v0i0.2008-1161. 2021

6. Adhikari, Kanchan P.; Boersma, Hielke Freerk; Coates, Roger; Coulor, Whitney; Gallego, Eduardo; Omrane, Latifa Ben; Suarez, Rodolfo Cruz-2021
Radiation protection infrastructure-challenges in developing countries-
https://doi.org/10.1088/1361-6498/ac0c0018.

7. Peter hiles-2021
Contemporary issues in radiation protection in medical imaging special feature: commentary using patient shielding.
https://doi.org/10.1259/bjr.20210701

8. Louis W.A. van Papendorp1 Farhana E. Suleman2 Heleen Hanekom-2020
The knowledge, awareness and practices of radiation safety amongst orthopaedic surgeons. https://doi.org/ 4(1), 10.4102/sajr.v24i1.1806.

9. Ivy June Boniface1 , Nur Maizatul Azra binti Mukhtar,2, 2020
A study on the importance of personal protective equipment (ppe) use in occupational radiation protection - Corresponding author: nurmaizatul038@ uitm.edu.my

10. Cécile R. L. P. N. Jeukens* , Gerhard Kütterer, Pierre J. Kicken, Marij J. Frantzen, Jos M. A. van Engelshoven , 2020
Gonad shielding in pelvic radiography: modern optimised X-ray systems might allow its discontinuation,
http://creativecommons.org/licenses/by/4.0/

11. Salah Eldeen NG1 and Farouk SA2-2020
Assessment of awareness and practice of ionizing radiation protection procedures among exposed health care workers
By: naneesghareeb@zu.edu.eg

12. M.M. Abuzaid1* , W. Elshami1 , M. Shawki2, D. Salama3 -2019
Assessment of compliance to radiation safety and protection at the radiology department (as -
DOI: 10.18869/acadpub.ijrr.17.3.439

13. W. Elshami1 and Christopher Steelman2-2017
Measurements of radiation exposure of radiography students during their clinical training using thermoluminescent dosimetry
doi:10.1093/rpd/ncx261

14. J. Radiol.-2017
Assessment of radiological protection systems among diagnostic radiology facilities in North East India
http://iopscience.iop.org/0952-4746/37/1/68

15. Int. J. Radiat.-2016
Radiation dose awareness of radiologic technologists in major Jordanian hospitals

14. Cristian Candela-Juana,*, Olivera Ciraj-Bjelacb, Marta Sans Mercec,d, J´ er´ emie Dabine, Dario Fajf,g, Aoife Gallagherh, Hugo de las Heras Galai, ˇ Zeljka Kneˇ zevi´ cj, Françoise Malchairk,l, Francesca De Montem, George Simantirakisn, Chrysoula Theodorakouo-2021
Use of out-of-field contact shielding on patients in medical imaging: A review of current guidelines, recommendations and legislative documents.
https://doi.org/10.1016/j.ejmp.2021.05.017

15. Harrison, J. D., Balonov, M., Bochud, F., Martin, C. J., Menzel, H-G., Smith-Bindman, R., Ortiz-López, P., Simmonds, J. R., & Wakeford, R. -2021
The use of dose quantities in radiological protection
doi/ 10.1088/1361-6498/abe548

16. MuhammadIkmalAhmad1,MohdHafiziAb. Rahim2,RosdiadeeNordin3,* ,Faizal Mohamed1, Asma' Abu-Samah 3 andNorFadzilahAbdullah-2021

Ionizing Radiation Monitoring Technology at the Verge of Internet of Things.
https://doi.org/10.3390/s21227629

17. Said Soudjay1, 2, *, Vololoniaina Bernardine2, Ramanandraibe Marie Jeanne2, 4, Ramanantsizehena Georgette Vololona3, Raboanary Roland3, Randriamora Tiana Harimalala-2021
Application of Radiation Protection of Patients in Medical Diagnostic Radiology
doi: 10.11648/j.ns.20210601.11

18. MohammadRasoul Tohidnia1, Azmoonfar Rasool1, Amiri Fatemeh1,*, Seyed Ali Rahimi2, Amiri Neda3 and Sharafi Hosna4-2020
Evaluation of radiation protection principles observance in dental radiography centers.
doi:10.1093/rpd/ncaa071

19. Choonsik Lee-2020
How to estimate effective dose for CT patients.
https://doi.org/10.1007/s00330-019-06625-7

20. F. Bochuda, M.C. Cantoneb, K. Applegatec, M. Coffeyd, J. Damilakise, M. del Rosario Perezf, F. Faheyg, M. Jesudasanh, C. Kurihara-Saioi, B. Le Guenj, J. Maloned, M. Murphyk, L. Reidl,F.Zolzerm-2020
Ethical aspects in the use of radiation in medicine: update from ICRP Task Group 109.
ICRP 2019 Proceedings

21. 2Ruben Pauwels, 3Keith Horner, 4Jenia Vassileva and 5Madan M. Rehani-2019
Thyroid shielding in cone beam computed tomography: recommendations towards appropriate use.
doi: 10.1259/dmfr.20190014

22. MH Rahman-2019
Radiation Hazard, Safety, Control and Protection
Faridpur Med. Coll. J. 2019;14(2):100-103

23. Rebecca M. Marsh1 Michael Silosky-2019
Patient Shielding in Diagnostic Imaging: Discontinuing a Legacy Practice.
doi.org/10.2214/AJR.18.20508

24. Hassan Zarghani1, Reza Jafari2,-2019
Risk Assessment of Public Gamma Radiation in Some Provinces of Iran.
Med Phys 2021; 18: 78-83. 10.22038/ijmp.2019.35081.1439.

25. A. Ribeiro a,*, O. Husson b,N.Dreyc, I. Murray a,K.Maya, J. Thurston a,W.Oyen-2019
Ionising radiation exposure from medical imaging e A review of Patient's (un) awareness.
https://doi.org/10.1016/j.radi.2019.10.002

26. Amanda Partap1 , Ryan Raghunanan1, Kimani White2 and Trevor Seepaul1-2019
Knowledge and practice of radiation safety among health professionals in Trinidad.
https://doi.org/10.1177/2050312119848240

27. H. Kaheni1, A. Chaparian2,*,R.Nafisi-Moghadam3 and N. Hamzian-2018
Assessment of image quality and radiation dose in some models of digital radiography systems.
https://doi.org/10.1051/radiopro/2018012

28. Hassan Zarghani1, Mohammad Taghi Bahreyni Toossi-2018
Local Diagnostic Reference Levels for Some Common Diagnostic X-Ray Examinations In Sabzevar County of Iran.
Med Phys 2018; 15:62-65. 10.22038/ijmp.2017.19211.1237.

29. L. O'Hora1,*, M.L. Ryan2 and L. Rainford2 1CHOArea 1, Donegal-2018
Survey of key radiation safety practices in interventional radiology: an Irish and english study.
doi:10.1093/rpd/ncy162

30. Gabriel Bartal, MD, FCIRSE, FSIR,*, Anna M. Sailer, MD, PhD,†,‡ and Eliseo Vano-2018
Should We Keep the Lead in the Aprons.
https://doi.org/10.1053/j.tvir.2017.12.002

31. Bo Kyung Cheon, Cho Long Kim, Ka Ram Kim, Min Hye Kang, Jeong Ae Lim,
Nam Sik Woo, Ka Young Rhee, Hae Kyoung Kim, and Jae Hun Kim-2018
Radiation safety: a focus on lead aprons and thyroid shields in interventional pain management.
https://doi.org/10.3344/kjp.2018.31.4.244

32. H. Bijwaard a,b,*, G. de Vries a, J. Scheurleer a, T. Roding a, H. Erenstein c, W. Ravensbergen c, S. Haarmans-Jonkman c, F. van Welie-2017
Compliance to Diagnostic Reference Levels for radiation exposure in common radiological procedures in Dutch hospitals: A nation-wide survey carried out by medical imaging students.
http://dx.doi.org/10.1016/j.radi.2017.03.005

33. Seyedeh Shohreh Alavi, Sima Taghizadeh Dabbagh1, Mahya Abbasi,-2017
Medical radiation workers' knowledge, attitude, and practice to protect themselves against ionizing radiation in Tehran Province, Iran.
10.4103/jehp.jehp_126_15

34. Thokchom Dewan Singh1,2, T Jayaraman2 and B Arunkumar Sharma3-2016
Assessment of radiological protection systems among diagnostic radiology facilities in North East India

doi:10.1088/1361-6498/37/1/68

35. Agapi Ploussi, Efstathios P Efstathopoulos-2016
Importance of establishing radiation protection culture in Radiology Department.
DOI: 10.4329/wjr.v8.i2.142

36. Kyung-Hyun Do-2016
General Principles of Radiation Protection in Fields of Diagnostic Medical Exposure.
http://dx.doi.org/10.3346/jkms.2016.31.S1.S6

37. jimma lone phd, fipemand2friedoz¨ olzer-2016
Pragmatic ethical basis for radiation protection in diagnostic radiology.
doi: 10.1259/bjr.20150713

38. Seung-Jae Hyun*, Ki-Jeong Kim, Tae-Ahn Jahng, Hyun-Jib Kim-2016
Efficiency of lead aprons in blocking radiation − how protective are they.
http://dx.doi.org/10.1016/j.heliyon.2016.e00117

39. Reinier C Hoogeveen, Bart Hazenoot, Gerard C H Sanderink and W Erwin R Berkhout-2016
The value of thyroid shielding in intraoral radiography.
doi: 10.1259/dmfr.20150407

40. Matthew E. Zygmont, MD, Jason N. Itri, MD, PhD, Andrew B. Rosenkrantz-2016
Radiology Research in Quality and Safety.
http://dx.doi.org/10.1016/j.acra.2016.07.021

41. Vahid Karami 1, *Mansour Zabihzadeh12, 3, Abdolreza Gilavand 4, Nasim Shams5-2016
Survey of the Use of X-ray Beam Collimator and Shielding Tools during Infant Chest Radiography.
Int J Pediatr, Vol.4, N.4, Serial No.28, Apr 2016

9 APPENDIX

SANTOSH
Deemed to be University
(Established u/s 3 of the UGC Act, 1956)

F. No. SU/R/2024/1344[53] Dated: 17.05.2024

Subject: Grant of Ethical Clearance for **Dissertation Protocol** Topic **"Radiation Safety and Standard Operational Compliances Guidelines by AERB in Radio",** submitted by **SUNIL KUMAR,** student of M.Sc Medical Imaging Technology, 2022 Batch.

*****

With reference to the request for grant of Ethical Clearance for the Dissertation Protocol entitled **"Radiation Safety and Standard Operational Compliances Guidelines by AERB in Radio", SUNIL KUMAR** is informed that the **Dissertation Protocol** submitted by him/her was considered by the **Screening Committee** of the **Allied Health Sciences** in its meetings held on 07.02.2024 and 29.02.2024. The recommendations of the **Screening Committee** were considered in detail by the **Institutional Ethics Committee** in its meeting held on **15.05.2024** and the same was **approved** by the **Ethics Committee** of the **Santosh Deemed to be University, Ghaziabad, Delhi NCR**.

He /She is informed accordingly for further necessary action.

17/5/24

[Dr. EZHILRAJAN. K]
REGISTRAR

SANTOSH DEEMED TO BE UNIVERSITY REGISTRAR GHAZIABAD, NCR DELHI

SUNIL KUMAR
M.Sc Medical Imaging Technology.

Copy to:

1. The Vice Chancellor
2. The Dean – Academics
3. The Dean, SMC&H
4. The Dean – Research
5. The Director - IQAC
6. HOD/ Course In-charge of the concerned Department.

Questionnaire sample:

Filed by –

A-RSO

B-TECHNICIAN

SECTION -A (Demographic Information)

Q-1 Age

A-25-30

B-30-35

C-35-40

D-40 Above

Q-2 Gender

A-Male

B-Female

C-Other

Q-3 What Is the Highest Level of Qualification?

A-Diploma

B-Bachelor's

C-Master's

D-Other

Q-4 What Is Your Experience in Years?

A-1-3

B-3-5

C-5-7

D- Above 7

Q-5 In Which Employment Setting do You Working?

A-Private Hospital

B-Imaging Centre

C-Clinics (Small/Large)

D-Government Hospital

E-Other

Q-6 In Which Area of Western Uttar Pradesh your Working Facility Belongs?

A-Gautam Budh Nagar

B-Ghaziabad

C-Bulandshahr

D-Aligarh

E-Hapur

F-Meerut

G-Saharanpur

H-Muradabad

SECTION -B (GENERAL)

Q -7 TLD Badges are provided to all the radiations workers?

A-Yes

B-No

Q – 8 Proper storage for TLD Badges is provided?

A-Yes

B-No

Q -9 Whether all your staff know about how to wear the TLD Badge?

A-Yes

B-No

Q -10 Whether control card is kept at a radiation free area?

A-Yes

B-No

Q- 11 Whether all radiation staff have annual health checkup facility?

A-Yes

B-No

Q – 12 Does your staff follow the acts and rules of radiation protection (2004)?

A-Yes

B-No

Q- 13 **Do you submit a safety report of your practice to AERB?**

A-Yes

B-No

Q-14 Whether your staff know about ELORA?

A- Yes

B-No

Q -15 Warning x-ray caution symbol is available on entrance door of all x-ray installations?

A-Yes

B-No

Q -16 Standard exposure charts are displayed near control console?

A-Yes

B-No

Q – 17 Separate paediatric protocols are available?

A-Yes

B-No

Q –18 Standard patient positioning charts are displayed in the x-ray room?

A-Yes

B-No

Q – 19 Dose records of radiation workers are maintained?

A-Yes

B-No

SECTION- C (EQUIPMEMT)

Q – 20 Whether all equipment's are safe and secured from radiation safety point of view?

A- Yes

B- No

Q-21 Whether operational status of equipment's in Elora are updated?

A-Yes

B-No

Q -22 Are radiation ON/OFF indicator lights connected to the radiation source available at the entry gate of radiation equipment's?

A-Yes

B-No

Q – 23 Records of service and maintenance of all x-ray equipment are maintained?

A-Yes

B-No

Q – 24 Periodic QA of all x-ray equipment is carried out and records maintained?

A-Yes

B-No

Q -25 Duplicate and wrong x-ray equipment's are decommissioned in ELORA?

A-Yes

B-No

Q -26 Whether all x-ray equipment layout as per AERB guidelines?

A-Yes

B- No

Q-27 Copy of license certificate is displayed in respective x-ray equipment's room?

A-Yes

B- No

Q -28 Acceptable test reports of all diagnostic x-ray equipment are maintained?

A-Yes

B-No

SECTION- D (SAFETY DEVICES)

Q – 29 Shielding adequacy of all available protective devices are satisfactory?

A-Yes

B-No

Q – 30 All protective barriers are provided with lead glass viewing window?

A-Yes

B-No

Q -31 Shielding adequacy of all walls of x-ray rooms are satisfactory?

A-Yes

B-No

Q -32 Proper storage of is provided for protective aprons when not in use?

A-Yes

B-No

Q -33 Test accuracy of shielding adequacy of protective barriers and protective aprons are maintained?

A-Yes

B-No

Q -34 Whether radiation safety devices are in working conditions?

A-Yes

B-No

Q -**35 Whether your staff using the gonad shield whenever required?**

A-Yes

B-No

A STUDY TO CHECK THE RADIATION SAFETY AND STANDARD OPERATIONAL COMPLIANCES GUIDELINES BY AERB IN RADIODIAGNOSIS DEPARTMENT OF WESTERN UTTAR PRADESH HOSPITALS, INDIA.

ORIGINALITY REPORT

1 %
SIMILARITY INDEX

PRIMARY SOURCES

1	daneshyari.com Internet	36 words — < 1%
2	pinnacle.allenpress.com Internet	28 words — < 1%
3	eprints.mums.ac.ir Internet	23 words — < 1%
4	www.slideshare.net Internet	22 words — < 1%
5	epos.myesr.org Internet	17 words — < 1%
6	pubmed.ncbi.nlm.nih.gov Internet	17 words — < 1%
7	iopscience.iop.org Internet	16 words — < 1%
8	recentscientific.com Internet	15 words — < 1%

9 nlist.inflibnet.ac.in
Internet

14 words — < 1%

EXCLUDE QUOTES	ON	EXCLUDE SOURCES	< 10 WORDS
EXCLUDE BIBLIOGRAPHY	ON	EXCLUDE MATCHES	< 14 WORDS